CEDAR

Professional Hardware Systems

DC-1 De-Clicker
Digital Audio Restoration System

SERIES 2

TABLE OF CONTENTS

INTRODUCTION

Thank you for purchasing the CEDAR DC-1 De-clicker. The original DC-1 was the world's first real-time dedicated digital de-clicking device, and the DC-1 *SERIES 2* offers even greater processing power and performance - power exceeding that obtained using digital signal processors (DSPs) installed in desk-top or larger computer systems (excepting, of course, the CEDAR Production Systems).

The DC-1 *SERIES 2* is designed for professional use, although it will work perfectly well in a domestic environment, and its features include the following:

- The latest 'SERIES-2' CEDAR hardware.

- Digital Audio interfaces conforming to the AES/EBU and SP-DIF standards.

- 24-bit input and output resolution when using AES/EBU interfaces

- Three sample rates supported on digital inputs: 32kHz, 44.1kHz and 48kHz

- Two sample rates supported on analogue inputs: 44.1kHz and 48kHz

- Balanced analogue inputs and outputs for connection to professional analogue equipment.

- ADC and DAC converters using the latest 64x over-sampling Δ-$\sum$ (Delta-Sigma) technology.

- >103dB dynamic range A/D and >93dB dynamic range D/A

- Mountable in a 19" EIA rack.

- Remote control via MIDI and RS232 interfaces.

- SMPTE/EBU timecode capabilities via optional upgrade

- Input and output LED bar-graph VU meters.

- Twin 40-bit floating-point DSP processors delivering 50MFlops to handle the most complex audio processing requirements.

- High levels of artificial intelligence designed into the DC-1 program algorithms making it extremely simple to use.

THE BACKGROUND TO SCRATCH REMOVAL

The term 'scratch' describes many different audio phenomena - ticks, pops, clicks, crackle and thumps - as well as genuine scratch-like artefacts. However, when analysed carefully, each of these degradations displays different sonic characteristics. Therefore, a single process attempting to remove all of these impulses would be an unacceptable compromise, incapable of total repair of any single category.

These degradations can be separated into three categories: thumps (which includes loud pops), scratches (including ticks and clicks), and crackle. The DC-1 *SERIES 2* has been designed to perform real-time scratch removal.

The operation of the DC-1 is digital, and any signal presented to the analogue inputs is internally converted to a suitable digital format by the integrated high quality analogue-to-digital converter (ADC). Following click removal the processed signal is converted back from digital format to analogue by the digital-to-analogue converter (DAC).

For use with records, films, video, and tape, no other device offers the power, facilities, or accuracy of the DC-1 *SERIES 2*.

SAFETY INSTRUCTIONS

CAUTION:

1.   **Read all of these instructions**
All safety and operating instructions should be read before the DC-1 *SERIES 2* is operated.

2.   **Save these instructions for future reference.**

3.   **Follow all warnings and instructions.**

4.   **Water and Moisture**
The DC-1 *SERIES 2* should not be used near water, and must not be exposed to rain or moisture. If the DC-1 is brought directly from a cold environment into a warm one, moisture may condense inside the unit. This, in itself, will not damage the DC-1, but may cause hazardous electrical shorting to occur. This could severely damage the DC-1 and even cause danger to life. ALWAYS allow time for the DC-1 to reach ambient temperatures before connecting the mains power.

5.   **Mounting**
The DC-1 *SERIES 2* should be carefully mounted in a 19" EIA rack, or placed on a flat, stable surface. If used on a cart or free stand, care should be taken when moved: uneven surfaces or excessive force may cause cart and DC-1 to overturn. Do not position the DC-1 in a place subject to strong sunlight, excessive dust, mechanical vibration or periodic shocks.

6.   **Wall or Ceiling Mounting**
The DC-1 *SERIES 2* has not been designed for mounting directly to walls or ceilings.

7.   **Ventilation**
Good air circulation is essential to prevent internal heat built-up within the DC-1 *SERIES 2*. The DC-1 should be situated so that its position does not interfere with proper ventilation. The DC-1 should not be placed in any situation that impedes the flow of air through the vents at the front and rear. Do not place the DC-1 on a soft surface.

8.   **External Heat Sources**
The DC-1 *SERIES 2* should be installed away from significant heat sources such as radiators, and (if possible) away from other audio devices such as amplifiers that produce large amounts of heat. Installation in racks with devices such as signal processors or tape machines should not be a problem.

9. **Power Sources**
The DC-1 *SERIES 2* features an auto-switching power supply which will work safely on any mains supply in the ranges 95v/130v and 190v/260v, 50Hz or 60Hz AC only.

You should never attempt to modify or adjust the internal power supply in any way. It contains no user serviceable parts.

10. **Grounding or Polarisation**
The DC-1 *SERIES 2* should always be grounded (or 'earthed').

11. **Power Cord Protection**
Power connectors should be routed so that they will not be walked on or pinched.

12. **Extended Periods of Non-Use**
The DC-1 *SERIES 2* is not disconnected from the mains power as long as it is connected to the wall outlet, even if the unit itself has been switched off. Therefore, if the DC-1 is not used for an extended period, unplug the unit from the wall. Pull the connector out by the plug, never by the cord itself.

13. **Cleaning**
Clean only with a dry cloth. NEVER use liquid cleaners such as alcohol or benzene on the DC-1 *SERIES 2*. NEVER use abrasive pads on the DC-1.

14. **Damage Requiring Service**
The DC-1 *SERIES 2* should be returned to qualified service personnel when:
- objects have fallen into the unit
- liquid has spilled into the unit
- the unit has been exposed to rain
- the unit fails to function or appears to operate abnormally
- the unit has been dropped, or the case damaged.

15. **Servicing**
The user should not attempt to service the DC-1 *SERIES 2* beyond the instructions contained in the User's Manual. All other servicing should be referred to qualified service personnel.

SET UP

1.   UNPACKING AND INSPECTION

Be careful not to damage the DC-1 *SERIES* 2 during unpacking. Save the carton and all packing materials since you may need them to transport the DC-1 *SERIES* 2 in the future.

In addition to the packaging, the carton should contain the following:

•   mains connection lead
•   this manual

2.   INSTALLATION SITE

The DC-1 *SERIES* 2 may be used in most areas, but to maintain reliability and prolong operating life observe the following environmental considerations:

•   Nominal temperature should be maintained between 5˚ and 35˚ Centigrade (41˚ and 95˚ Fahrenheit).

•   Relative humidity should be in the range 30% to 60% non-condensing.

•   Strong magnetic fields should not exist nearby.

3.   RACK MOUNTING

The DC-1 *SERIES* 2 can be mounted in a standard 19" EIA rack.

4.   FREE STANDING USE

The DC-1 *SERIES* 2 can be used as a freestanding unit. The blanking plates may then replace the rack-mount ears if desired.

To replace the ears with the blanking plates:

•   Unscrew the three bolts that attach each ear to the chassis of the DC-1.

•   Attach the blanking plates using the same retaining bolts. Do not over-tighten these bolts as doing so may cause damage to the DC-1.

CONNECTIONS

The DC-1 *SERIES 2* may be connected to most of the professional audio equipment currently available. Three types of audio input and output are provided (one analogue and two digital) and these will satisfy most users' interconnection requirements. Full descriptions of these connectors will be found later in the manual.

1.   BEFORE CONNECTION

- To prevent problems and possible equipment damage, turn off the power to all equipment before making connections.

- Be sure to insert plugs firmly into sockets. Loose connections may cause hum and noise.

- When unplugging any lead, do so by grasping the plug, not the lead.

2.   POWER CONNECTIONS

Ensure that the DC-1 *SERIES 2* is switched OFF before inserting the mains lead.

NOTE: Users with 2-pin mains supplies:
When the DC-1 *SERIES 2* is connected to other audio components, the AC hum of the unit may be increased or decreased by reversing the direction of the power connector in the socket. Check that the cord is in the favourable position ('in-phase') with respect to other audio devices in the chain. This will ensure that you obtain the best sound quality from your DC-1.

For further information on grounding and polarity, consult a person familiar with studio grounding techniques.

3.   SIGNAL LEAD CONNECTIONS

Refer to the Rear Panel diagram:

The DC-1 *SERIES 2* offers three audio connection standards: one analogue and two digital. These are:

- balanced analogue audio I/O
- digital SP-DIF format audio data
- digital AES/EBU format audio data

*Note that the DC-1 SERIES 2 always passes its output to all three signal outputs irrespective of the input used, but that the digital data will only be formatted for **either** AES/EBU **or** SP-DIF, as defined by the user parameters.*

(i)   **Balanced analogue audio I/O   (Pin 2 - 'hot')**

This standard is used in professional audio equipment. Connect the output from your source to the balanced analogue inputs of the DC-1 *SERIES 2* using standard XLR plugs. You will require two such connections: one for each channel.

The balanced audio output may be used to connect the DC-1 *SERIES 2* directly to audio equipment such as mixing desks and professional recorders featuring balanced XLR inputs and outputs.

(ii)   **Digital SP-DIF format audio data**

The SP-DIF format is used by domestic and semi-professional digital audio devices such as DAT machines, some ADCs, and some CD players. Both audio channels are carried along a single cable, so you may connect the SP-DIF output from your source to the SP-DIF input of the DC-1 *SERIES 2* using a single cable terminated with RCA (or 'phono') plugs.

The SP-DIF output of the DC-1 *SERIES 2* may be connected to the SP-DIF input of your recording device or external DAC.

(iii)   **Digital AES/EBU format audio data**

The digital AES/EBU format is used by professional digital audio devices including mastering systems, DASH recorders, and high quality ADCs & DACs. Both channels of audio are carried along a single cable, so you may connect the AES/EBU output from your source to the AES/EBU input of the DC-1 *SERIES 2* using a single cable terminated with XLR plugs.

The AES/EBU output of the DC-1 *SERIES 2* may be connected to the AES/EBU input of your digital mixer, recording device or external DAC.

24-bit Digital data resolution:

The DC-1 *SERIES 2* features 24-bit input and output resolution whenever the AES/EBU digital input and output are utilised.

Dithering:

The DC-1 *SERIES 2* also features TPDF (Triangular Probability Density Function) dithering. This is applied to the digital data when the SP-DIF output format is selected. Dithering is always applied to the data presented to the DACs.

In order to comply fully with EMC regulations, this unit should be connected via its AES/EBU and/or analogue connectors. Metal-shelled XLR connectors should be used. We recommend using a good quality 'starquad' cable, with three cores connected to pins 1, 2 & 3. The shield of the cable should be connected, at both ends, to the outer shell of the connector.

4.   OTHER CONNECTIONS

(i)   SMPTE/EBU
An optional SMPTE/EBU interface offering LTC and VITC protocols is available for the DC-1 *SERIES 2*. The standard DC-1 *SERIES 2* does not support timecode and these connectors are not present.

(ii)   MIDI IN/OUT/THRU
The operation of the DC-1 *SERIES 2* may be controlled using the Musical Instrument Digital Interface (MIDI). Refer to the chapter on Remote Control Protocols for further instructions.

(iii)   RS232
The DC-1 *SERIES 2* may be controlled using the standard RS232 serial communications protocol. Refer to the chapter on Remote Control Protocols for further instructions.

SAMPLE INSTALLATION IDEAS
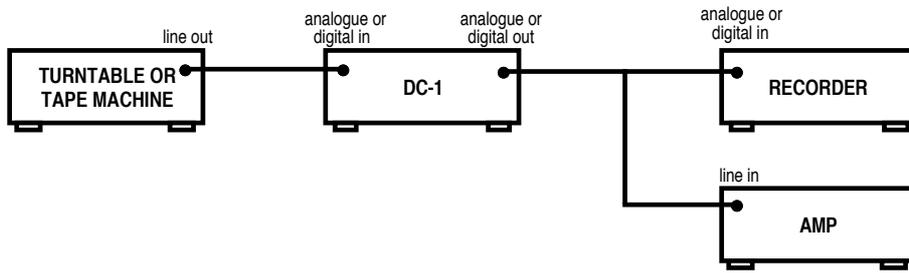
1.   *DC-1 SERIES 2 used in-line for transcription or broadcast purposes.*
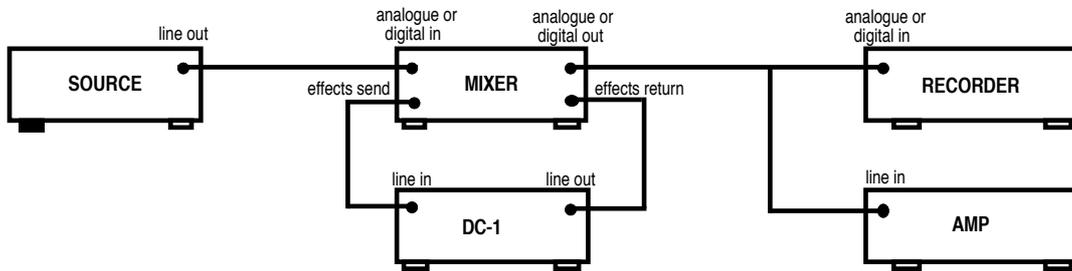
2.   *DC-1 SERIES 2 used on the effects loop within a studio environment.*
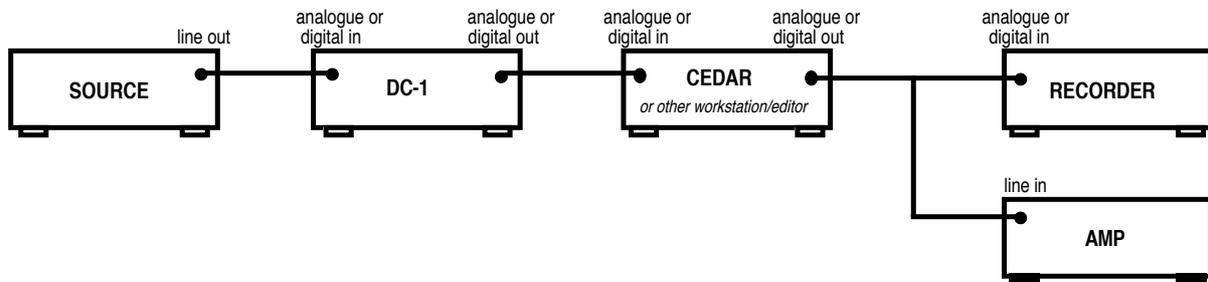
3.   *DC-1 SERIES 2 used in-line prior to an editor or audio workstation.*

A GUIDE TO RESTORATION PROCESSING

Contrary to 'common sense', the order in which restoration processes are carried out makes a great deal of difference to the quality of the result. Consequently, there is one 'right way' and many 'wrong ways' to restore your material.

Following these guidelines will help you to achieve the best results on most material:

- De-Clicking (De-Scratching) should ALWAYS be carried out first. This is because:

    i   Large clicks make it difficult for the De-Crackling process to identify and remove the tiny clicks and crackles that constitute surface noise, buzz, and other such problems.

    ii   All clicks and scratches are, in effect, tightly defined packets of white noise. If clicks are presented to any of the CEDAR De-Hiss products (HISS-1, HISS-2, DH-1 De-Hiss) they confuse the processes, and create unmusical side effects. In addition, De-Hissing at this stage will make it almost impossible to identify and remove clicks and scratches later.

- De-Crackling should be the next process because even small crackles can cause the same problems as in (ii) above.

- Azimuth Correction can be carried out either before or after De-Hissing, but experience shows that best results are obtained using the AZ-1 or Phase-EX module before De-Hiss.

- Finally, apply whichever De-Hiss process you wish to use.

Note: If you have the full range of CEDAR restoration modules, they should be connected as shown in the diagram overleaf. Please note that, to maintain the maximum fidelity and remove and possible sources of degradation between processes, connections between modules should be by AES/EBU (24-bit) format.
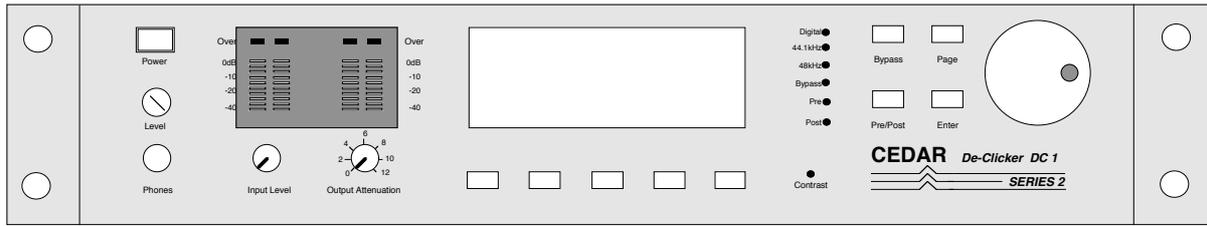
Firstly, De-Click your material
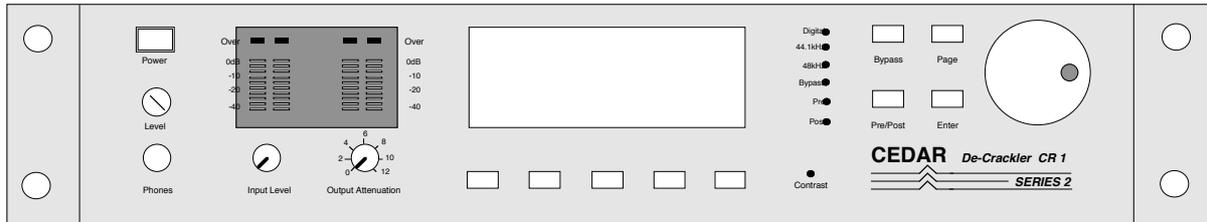
Next, remove crackle and buzz, and reduce distortion if appropriate
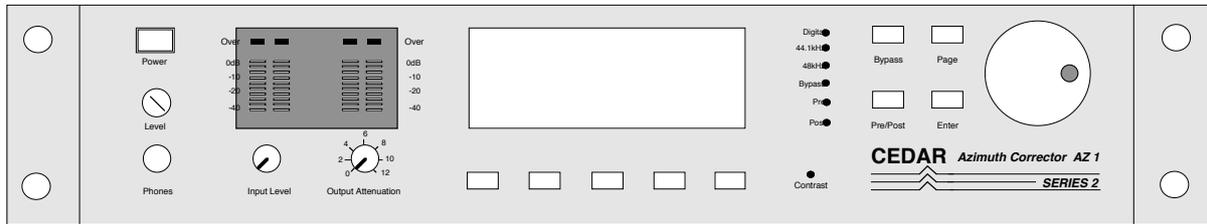
Then apply Azimuth Correction to material with phase and balance problems
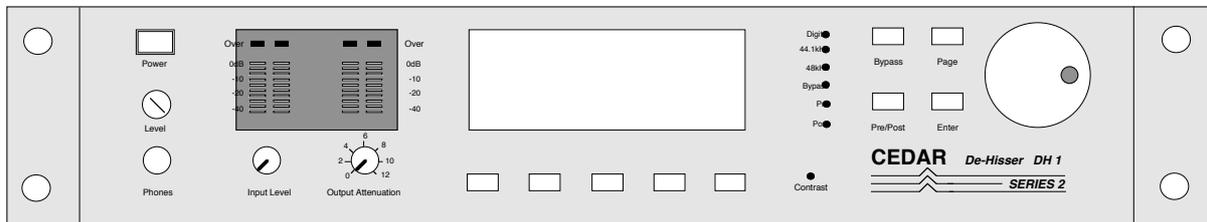
Finally, apply noise reduction.

LOCATION AND FUNCTION OF FRONT PANEL INDICATORS AND CONTROLS

Refer to the Front Panel diagram:

1.   Power Switch

2.   Input Signal Meters (Left and Right)
Digital signal meters display the peak value of the selected input in dB0s.

The 'Over' indicators will light if the input signal remains at full scale for four or more consecutive samples.

3.   Output Signal Meters (Left and Right)
Calibrated signal meters display the RMS value of all output signals.

The 'Over' indicators will light if the output signal remains at full scale for four or more consecutive samples.

4.   LCD Screen
Provides you with a variety of information and messages, keeping you aware of what is currently happening in the DC-1 *SERIES 2*.

All the control screens of the DC-1 *SERIES 2* are displayed on the LCD screen. Please refer to the following chapters for full instructions.

5.   Status Indicators
Indicate the status of the analogue and digital inputs, and whether the DC-1 *SERIES 2* is in idle or processing modes.

Also indicate the possible causes should the unit fail to function.

6.   Dedicated Function Keys.
Certain functions are fundamental to operating the DC-1 *SERIES 2*, and these are controlled by the Dedicated function keys: Bypass, Page, Pre/Post, and Enter.

7.   Spinwheel)
The spinwheel enables you to increase and decrease control values. Please refer to the following chapters for full instructions.

8.   Headphone Socket
For use with stereo headphones only. Accepts a standard 1/4" stereo jack plug. DO NOT use 2-conductor mono headphones with the DC-1 *SERIES 2*.

9.   Headphone Level Control
Use this to adjust for a satisfactory listening level. This level control will not alter the signal level at any of the rear panel outputs.

10.   Input Level Control

This control acts upon the analogue inputs only. Use it to adjust the volume of incoming analogue signals to the desired level. A level of approximately 0 to -3dB (as shown on the Input Signal Meters) will offer best results.

The Input Level Control may be bypassed internally to obtain the best possible signal to noise ratio (S/N) from the ADCs. This work must be carried out by qualified service personnel, so please refer to your authorised dealer or directly to CEDAR Audio to have this modification performed.

11.   Output Attenuation Control

A digital gain control with range 0 to -10dB in 1dB steps.

12.   Function Keys

Use along with the LCD screen. Please refer to the following chapters for full instructions.

13.   Contrast Control

Adjusts the LCD screen for optimum visibility. Use a fine screwdriver to make such adjustments.

QUICK TOUR

If you are impatient to hear some immediate results using your DC-1 *SERIES 2* the following instructions should have you up and running within a few minutes:

1.   READ THE SAFETY INSTRUCTIONS.

2.   Connect the DC-1 *SERIES 2* to the mains supply.

3.   Connect your input and output devices to the DC-1 *SERIES 2* using the appropriate input and output sockets. (If in doubt, please refer to the section CONNECTING THE DC-1 *SERIES 2* and the manuals of your other equipment).

4.   Hold down the function key F1 and switch on the DC-1 *SERIES 2*.

5(i)   If you are using analogue inputs press PAGE once. Press B to select 'analogue'. Then press PAGE twice more to return to the Control Page.

5(ii)   If you are using digital inputs from a consumer format machine such as a domestic DAT recorder press PAGE once, then press B twice to select 'SP-DIF'. If you are outputting to a consumer format machine such as a low-cost DAT recorder press A to select SP-DIF format.

Press PAGE twice to return to the Control Page

Note: The DC-1 SERIES 2 defaults to AES/EBU PROFESSIONAL format, so skip both instructions 4(i) and 4(ii) if your DC-1 SERIES 2 is connected to a system such as the Sony PCM1630.

6.   Play your material.

7.   Press PRE/POST to hear an immediate difference between the processed and unprocessed signals (assuming, of course, that your original material suffers from clicks and scratches).

This section should have whetted your appetite, so you should now proceed to the rest of the manual to ensure that you can obtain the best results from your CEDAR DC-1 *SERIES 2*.

WARMSTART AND COLDSTART

The DC-1 *SERIES 2* features Warmstart and Coldstart options. Warmstart has been added so that the unit can be configured once, and these parameters are then recalled on every power-up. This is ideal for applications where time-consuming set-ups at the start of each session are not practical.

Coldstart

If the DC-1 *SERIES 2* has not been used for some time the system will automatically Coldstart. This process initialises all parameters to their factory default values, and after a few seconds will automatically enter at Page 1.

On start-up, the message 'Coldstart' will be displayed at the top right of the start-up screen on the LCD display. The screen will then enter PAGE 1, which will show the default Parameters:

The default values are:	Threshold	=	10
	Mode	=	Medium
Other default values are:	Digital Output	=	AES/EBU
	Input Source	=	AES/EBU
	Receiver Error Level	=	1 - Lock
	MIDI	=	Channel 1
	Bypass	=	OFF
	A to D frequency	=	44.1kHz
	Pre/Post	=	Post

Warmstart

The DC-1 *SERIES 2* remembers the latest parameters used, and the page that was active at the time that the system was last switched off.

On start-up the DC-1 *SERIES 2* will display the message 'Warmstart' on the screen, and after a few seconds will re-enter at the appropriate page, with all user parameters set to their previous values.

User Coldstart

If you wish to force the DC-1 *SERIES 2* to Coldstart, hold down Function Key F1 while switching on the system. Release F1 when the message Coldstart is seen on the LCD display.

*Note: In common with all other digital devices, and irrespective of whether you are Warmstarting or Coldstarting the DC-1, you should always allow a few seconds between switching the unit **off**, and switching it **on** again.*

OPERATING THE CEDAR DC-1 *SERIES 2*

1.   DEDICATED CONTROLS:

The DC-1 *SERIES 2* features a number of dedicated controls to speed operation. These are:

Dedicated Function Keys:
- Bypass
- Page
- Pre/Post
- Enter

I/O Level Controls
- Input Level
- Output Attenuation

These are now explained in turn:

Bypass

You may wish to bypass completely the operation of the DC-1 *SERIES 2*. Press BYPASS to do this. The current status will be indicated on the Status LED.

The Bypass does not 'hard-wire' the input to the output. Analogue signals still pass through the AtoD and DtoA stages.

Notes: •   *There is a delay of approximately 1.3mS in any analogue-to-analogue signal passed through the DC-1 SERIES 2 in Bypass mode.*

•   *There is a delay of approximately 0.1mS in any digital-to-digital signal passed through the DC-1 SERIES 2 in Bypass mode.*

•   *All delays are 'group delays' (i.e. are constant at all frequencies) and are measured at a sample rate of 44.1kHz.*

Page

Use this Function Key to move between Pages.

Pre/Post

It will often be useful to compare the original signal with the post-processing output of the DC-1 *SERIES 2*. The current status will be indicated on the Status LEDs.

Enter

The ENTER Key has three functions: as a LOCK-OUT key, preventing accidental changing of parameters; as a CLEAR key, resetting error messages, and as a MIDI DUMP command.

These first two functions are, of course, context sensitive, and the key's action will be appropriate to the page displayed (see below). The MIDI DUMP will be initiated every time that the ENTER key is pressed, regardless of context.

Input Level

This control acts upon the analogue inputs only. Use it to adjust the volume of incoming signals to the desired level. We recommend a peak level of approximately 0 to -3dB as shown on the Input Signal Meters.

Output Attenuation

Avoid clipping using the Output Attenuation Control. This is not a compressor or limiter, and acts purely as a digital gain control with variable gain from 0dB to -10dB in 1dB steps.

OPERATING THE CEDAR DC-1 *SERIES 2*

2.   PAGES:

The DC-1 *SERIES 2* has three 'pages' which control all aspects of its operation. Each page is displayed on the LCD screen, and may be controlled using the Function Keys and the spinwheel.

Switch the DC-1 *SERIES 2* on. (Refer first to the safety instructions.)

The screen will immediately enter the CONTROL PAGE, which will show the Warmstart parameters stored when the unit was last used.

All the controls for the DC-1 *SERIES 2* are contained in the three PAGES, each of which is selected by pressing the dedicated **PAGE** function key. The Pages are cycled, and will appear in the following order:

•   Control Page
•   I/O Control Page
•   Remote Control Page

These, and a further description of the Dedicated Controls, are now covered in turn.

Note: There is a fourth, normally hidden, page called the Status Page. This is not accessed using the standard 'Page' function, and will be discussed separately in the section describing Error Levels.

PAGE 1:   CONTROL PAGE

Access this page by pressing the Defined Function Key 'PAGE' repeatedly until the CONTROL PAGE appears.

Threshold Level

This determines the size of scratch removed by the DC-1. A high threshold tells the system to remove only the largest clicks and scratches, while a lower threshold also removes fine ticks and clicks.

WARNING: *If the threshold for a given piece of music is too low, distortion of the genuine signal may result.*

 Typical thresholds to use are as follows:

Large scratch removal:	20+
Large click removal:	15
Smaller click removal:	8
Very small tick removal:	5

Increase or decrease the threshold by turning the spinwheel clockwise or anticlockwise (respectively).

To adjust the Channels individually:

At the bottom of the screen you will find three items of information. These are:

•   the Left Threshold (numeric value)
•   the Mode
•   the Right Threshold (numeric value)

You will note that both thresholds are surrounded by boxes. This shows that they are SELECTED, and that the action of the spinwheel applies to both channels.

To de-select a channel (and to re-select it as desired) press the Function Key immediately below the read-out. The box will disappear, showing that the channel is now DE-SELECTED.

If both channels are de-selected, the spinwheel will have no effect.

Mode

The CEDAR DC-1 can optimise its scratch removal depending on whether the material being processed suffers predominantly from large scratches, or from smaller ticks and clicks. The Scratch Mode parameter enables you to select the most appropriate setting for each restoration:

Small: Use this setting when the damage is predominantly small clicks and ticks.

Medium: This is a compromise setting lying between the 'small' and 'large' settings.

Large: Use this setting when the material suffers from larger 'thump'-like scratches.

Press the Function Key under the word MODE to toggle between the Scratch Mode settings.

WARNING: Signal degradation may occur if an inappropriate Scratch Mode setting is used.

PAGE 2:   INPUT/OUTPUT CONTROL PAGE (I/O CONTROL)

Access this page by pressing the Dedicated Function Key PAGE repeatedly until the I/O CONTROL PAGE appears.

This page allows you to determine the input used, the sampling frequency of the Analogue to Digital Converters, the digital input error detection level, and the digital output format.

(Remember that all outputs are permanently active, and that they do not require selecting, but that the same digital data is supplied to both AES/EBU and SP-DIF outputs. The data format will therefore only be appropriate for one digital output at any given time.)

There are three options in the I/O Control Page:

A.   DIGITAL OUTPUT:

This option defaults to AES/EBU. To toggle between the two output modes, AES/EBU and SP-DIF, press the Function Key marked 'A' on the LCD screen.

- AES/EBU FORMAT:

    When AES/EBU is selected, both the phono and XLR connectors will carry AES/EBU specification audio data. You should patch the output from the XLR connectors to your recording device.

    The DC-1 *SERIES 2* features 24-bit input and output resolution when AES/EBU is selected.

- SP-DIF FORMAT:

    When SP-DIF is selected, both the phono and XLR connectors will carry SP-DIF specification audio data. You should patch the output from the phono connectors to your recording device.

    TPDF dithering will be applied to the digital data at the 16-bit level and is always applied at the analogue output.

B.   INPUT SOURCE:

There are three input sources: AES/EBU, SP-DIF and ANALOGUE.

To toggle between the input sources press the Function Key marked 'B' on the LCD screen. The Status LEDs will indicate the inputs selected and the sample rate received (digital) or selected for conversion (analogue).

•   SAMPLE RATE OF INCOMING DIGITAL SIGNAL:

When the DC-1 *SERIES 2* is switched to receive digital audio data, the 'DIGITAL' LED will be lit, and the front panel LEDs will indicate the sample rate of the digital signal presented to the inputs:

        neither 44.1 nor 48 kHz LED lit = 32kHz signal presented to inputs
                        44.1 kHz LED lit = 44.1kHz signal presented to inputs
                          48 kHz LED lit = 48kHz signal presented to inputs

•   CLOCK DETECTION:

If the DC-1 *SERIES 2* fails to detect a digital signal within the following limits, the 44.1kHz and 48kHz LEDs will flash continually. This will be irrespective of any other system settings.

Acceptable ranges: 44.1kHz ± 4%
                             48kHz ± 4%
                             32kHz ± 4%

•   SAMPLE RATE OF A TO D CONVERTERS

When the DC-1 *SERIES 2* is switched to receive analogue audio data, the 'DIGITAL' LED will not be lit, and the front panel LEDs will indicate the sample rate of the analogue-to-digital converters.

The ADCs in the DC-1 *SERIES 2* do not offer a 32kHz option unless synchronised to an external 32kHz source.

C.   A TO D FREQUENCY (INPUT SOURCE = ANALOGUE)

The ADC frequency may be selected by two, fundamentally different, methods. The first is to select one of the internal clock frequencies available, the second is to control the sample rate by using an external clock.

•   INTERNAL CLOCK FREQUENCIES

To toggle between the DC-1s internal 44.1kHz and 48kHz sampling frequencies (and between AES Sync and SP-DIF Sync - see below) press the Function Key marked 'C' on the LCD screen. The change in frequency will be shown on-screen and by the Status LEDs.

Note: The sampling frequency reverts to 44.1kHz on Coldstart.

•   EXTERNAL SYNCHRONISATION

The DC-1 *SERIES 2* clock may be synchronised to either the AES/EBU input or the SP-DIF input. Connecting a valid digital input to either of these and selecting AES Sync or SP-DIF Sync (as appropriate) will lock the DC-1 *SERIES 2* to the external clock.

If the external clock falls within the acceptable ranges of each of the standard sample rates (44.1kHz, 48kHz, 32kHz) the clock frequency will be shown on the LEDs. If the external clock lies outside these ranges the DC-1 *SERIES 2* will still function, and good audio will be produced at the analogue output. Whether the digital output will be usable will then be determined by the flexibility of other devices in the digital audio chain.

To toggle between AES Sync and SP-DIF Sync options (and between the DC-1s internal 44.1kHz and 48kHz sampling frequencies) press the Function Key marked 'C' on the LCD screen.

Note: *If external synchronisation is requested, but no valid signal is detected at the appropriate digital input, the DIGITAL LED will flash to indicate the error.*

D. RECEIVER ERROR LEVEL
   ## (INPUT SOURCE = AES/EBU or SP-DIF)

The DC-1 *SERIES 2* features sophisticated software which detects and analyses both fatal and non-fatal errors in the incoming digital audio data.

You may select one of four error levels that will cause the front panel 'DIGITAL' LED to flash if the incoming data contains an error equal to or worse than the selected level.

The error levels are:

*   **1 - Lock**

        This is the 'weakest' detector and will only cause the LED to flash when the DC-1 *SERIES 2* believes that there is no usable signal being presented to the selected digital input.

*   **2 - Code**

        If there is an incoming signal yet the LED flashes on error level 2, the DC-1 *SERIES 2* is indicating that the signal contains coding violations. In some cases, you may obtain usable audio. However, this warning may be caused by non-AES/EBU or non-SP-DIF data being presented. In these cases, any audio produced will almost certainly be unusable.

*   **3 - Trans**

        This indicates that the incoming digital audio data is of poor quality (i.e very noisy or jittery) and that undetectable data errors are likely. These errors will not be corrected by any standard AES/EBU or SP-DIF device and may lead to audio degradations.

*   **4 - Valid**

        This is the most stringent test of the incoming data, and will cause the LED to flash if the DC-1 *SERIES 2* determines that any of the data contained in the signal is not valid. This is often non-fatal (i.e. you will hear perfectly good audio) but it indicates that some device or anomaly in your audio chain is generating digital audio data outside of the AES/EBU or SP-DIF specifications. Please note however that, if the digital LED does not flash, this can not be taken as an absolute statement that the signal conforms to specification.

Note: If the error level selected detects an error, the digital audio signal will be coded as INVALID by the DC-1 SERIES 2. Many manufacturers' devices do not recognise or act upon this code, but those that do may refuse to accept or record the audio.

PAGE 3:   REMOTE CONTROL

Access this page by repeatedly pressing the Dedicated Function Key PAGE until the REMOTE CONTROL PAGE appears.

The DC-1 *SERIES 2* features intelligent 'auto-detection' software which monitors the RS232, MIDI, and SMPTE/EBU (if fitted) inputs and responds to data received on each and any of them. This eliminates the need for a control to select the remote control to be used.

It is only necessary, therefore, to select the Channel on which the DC-1 *SERIES 2* receives commands over MIDI.

MIDI

CEDAR Audio Ltd do not produce software for remote devices to control the DC-1 *SERIES 2* over MIDI.

•   MIDI CHANNEL

Ensure that button A is highlighted by a box. It is then possible to change the MIDI Channel turn the spinwheel clockwise (to increase) or anti-clockwise (to decrease) the MIDI Channel.

To toggle this function on/off press the Function Key marked 'A'.
On Coldstart, the MIDI Channel defaults to 1.

RS232

CEDAR Audio Ltd does not produce software for remote devices to control the DC-1 *SERIES 2* over RS232. However, for users wishing to implement their own control software, the RS232 Protocol is outlined in the chapter 'RS232 Protocol'.

SMPTE/EBU Timecode

A separate SMPTE/EBU reader/generator board may be purchased and fitted inside your DC-1 *SERIES 2*. Please contact your dealer for details of this.

PAGE 4: STATUS PAGE

Access the Status Page by holding down Function Key F5 and then pressing the Dedicated Function Key PAGE.

Should the DC-1 *SERIES 2* fail to function, or appear to function incorrectly, there may be an error contained within the digital audio data received at the System's inputs. The Receiver Error Level (see above) will notify you when an error has occurred, but it will not tell you what it is. For many users, this information will be adequate, but the DC-1 is capable of reporting errors and other status information in more detail.

The STATUS PAGE will give you information regarding the status of the DC-1, and will give you details regarding any errors that have occurred since the unit was switched on.

Three items of information will always be reported by the DC-1 *SERIES 2*. These are:

•	DSP1:	Status	Crashed / Timed Out / Running
•	DSP2:	Status	Crashed / Timed Out / Running
•	I/O:	Condition	Error / Emphasis, Sample Rate

If a remote control error is detected, a fourth field will appear:

•	Comms:	Error	Illegal Checkbyte / Illegal Command Size

STATUS INDICATORS

The front panel LEDs will help to identify the possible cause if the unit fails to function. The following table lists all possible combinations of LED error indications:

LED flashing:		Condition:
Digital	-	the digital input violates the Receiver Error Level
	-	*or* no digital sync is present (if requested in I/O page)
44.1 *and* 48kHz	-	unknown sample rate received at inputs
Bypass/Pre/Post	-	One or both of the DSPs have crashed.

STATUS PAGE DEFINITIONS:

Crashed

The DC-1 *SERIES 2* DSPs are failing to function. The only recourse is to switch the unit off, wait for a few seconds, and then switch on again. If this error re-occurs please refer your DC-1 *SERIES 2* to an authorised service centre.

Timed Out

If, for any reason, the DC-1 *SERIES 2* drops out of real-time (fails to pass audio to the output) this error will be reported. This should only occur if a sample rate of greater than 50kHz is presented to one of the digital inputs. This error is non-fatal, and the DC-1 *SERIES 2* should continue to function normally after it has occurred.

Running

The DC-1 *SERIES 2* DSPs are functioning correctly and have been doing so since the unit was switched on.

Error

If the DIGITAL LED is flashing the most serious error will be detailed at this point. Errors are fully detailed in the DC-1 *SERIES 2* Service Manual.

Emphasis

If no error is detected, the I/O status will display the Emphasis condition:

•   OFF

The Emphasis bit is not set.
The DAC de-emphasis will not be engaged.

•   50/15

The Emphasis bit is set to 50/15 µS.
The DAC de-emphasis will be engaged.

•   J17   (AES/EBU only)

The Emphasis bit is set to CCITT J17.
The DAC de-emphasis will not be engaged.

•   Unknown   (AES/EBU only)

The Emphasis status is not indicated.
The DAC emphasis status will not be altered.

Sample Rate

If no digital data error is detected, the measured sample rate presented to the digital inputs will be displayed to the nearest 100Hz.

Illegal Checkbyte

The RS232 or MIDI has received a command packet containing an illegal checkbyte (byte2).

Illegal Command Type   The RS232 or MIDI has received a command packet
                         containing an illegal command type (byte4).

NOTES AND HINTS TO USERS

CEDAR Scratch removal is an *almost* foolproof process. However, there are rare instances when experience of its occasional quirks is useful. These notes have been written by the in-house Engineers at Cambridge Sound Restoration, and should aid your quick progress to full understanding and competence.

Low thresholds are most effective at removing all classes of scratch, click, and tick. However, a higher threshold is advisable if processing begins to introduce distortion.

If distortion is introduced, it will be most noticeable as a burbling sound (rather than the traditional Jimi Hendrix fuzz), particularly following the transients of harsh sounds such as trumpets or synthesised brass. To avoid this, try raising the threshold a little. In general, no distortion will occur with a threshold of 8 or above.

When you select the Large Mode, it will be necessary to use higher thresholds than typical for Small and Medium modes. This is a consequence of the differences between the algorithms used in the modes.

In special cases (noticeably high pitched, high amplitude big-band brass) the descratch process will not totally de-click without distortion. CEDAR Audio now produce a dedicated unit, the CEDAR CR-1 De-Crackler, to remove small ticks and crackles from material such as this. In addition, the CR-1 will remove crackles from all other types of material, remove buzzes and reduce some forms of amplitude distortions.

There are also processes on the computer-based CEDAR System which restore material suffering from crackle, buzzes, and distortion. Please contact CEDAR Audio Ltd or your national distributor for details of this, and other advanced CEDAR processes.

REMOTE CONTROL PROTOCOLS

1.   RS232

RS232 is defined in the DC-1 *SERIES 2* as:

> **9600 baud**
> **8 bits data**
> **1 stop bit**
> **No parity**

A command packet contains 6 bytes. These are:

byte 1:   channel number byte: must be 0xAF
byte 2:   Checkbyte. Fixed: must be 0x63
byte 3:   command number (see below)
byte 4:   Command type. Fixed: 0x07
byte 5:   command value HIGH byte
byte 6:   command value LOW byte

The HIGH and LOW bytes together form a signed integer.

Command Numbers: **Command Values:**

0xF7	Clear Errors command	Any value	=	Clear all error messages
0xF8	Select Page command	1	=	Control Page
		6	=	I/O Control Page
		7	=	Status Page
		15	=	Remote Control Page
		-1	=	Toggle between Pages
		Any other value	=	Refresh
0xF9	Pre/Post command	0	=	Pre
		1	=	Post
		-1	=	Toggle
		Any other value	=	Refresh
0xFA	Bypass command	0	=	Bypass OFF
		1	=	Bypass ON
		2	=	RESERVED VALUE
		3	=	RESERVED VALUE
		-1	=	Toggle
		Any other value	=	Refresh
0xC0	Digital Output Format	0x80	=	SP-DIF
		0x00	=	AES/EBU
		-1	=	Toggle
		Any other value	=	Refresh

0xC1	Input Source	0	=	Analogue
		1	=	SP-DIF
		2	=	AES/EBU
		-1	=	Toggle
		Any other value	=	Refresh
0xC2	A to D Frequency	0	=	44.1kHz
		1	=	48kHz
		2	=	SP-DIF Sync
		3	=	AES/EBU Sync
		-1	=	Toggle
		Any other value	=	Refresh
0xC3	Receiver Error Level	0	=	1 - Lock
		1	=	2 - Code
		2	=	3 - Trans
		3	=	4 - Valid
		-1	=	Toggle
		Any other value	=	Refresh
0x22	Set Left Threshold	Any value	=	Left Threshold x 100

The minimum threshold is 0.
The maximum threshold is 40

0x32	Alter Left Threshold	Any value	=	Δ (Left Threshold) x 100
0x23	Scratch Mode	0	=	Small
		1	=	Medium
		2	=	Large
		-1	=	Toggle
		Any other value	=	Refresh
0x24	Set Right Threshold	Any value	=	Right Threshold x 100

The minimum threshold is 0.
The maximum threshold is 40

0x34	Alter Right Threshold	Any value	=	Δ (Right Threshold) x 100

2.   MIDI

The DC-1 is permanently set to transmit any change of control page parameters or Pre/Post state via MIDI except when such a change is initiated by an RS232 or MIDI command. Therefore, if a MIDI sequencer such as Cubase™, Notator™, or EditTrack™ is connected to the DC-1, it will receive a running history of the unit's operation.

If your sequencer and audio sources are able to send and receive timecode, then the DC-1's MIDI capability may be used as the basis for an automation system.

Note: The absolute parameter values are not transmitted or received, so the user must ensure that any changes are relative to a desired starting value which can be set using MIDI DUMP.

If a MIDI DUMP of all control page parameters and the Pre/Post state is required, pressing ENTER at any time will initiate the DUMP.

Additional MIDI Command

The DC-1 will receive LOCAL ON and LOCAL OFF commands.
The Status Page will notify you of the current state.
Both WARMSTART and COLDSTART always set LOCAL ON.

You can not initiate this command from the front panel of the DC-1.

SELF TEST MODE

The DC-1 *SERIES 2* features a powerful self-test mode which enables the System to check the operation of each of its major sub-systems, plus all of the user controls.

To enter the self-test mode:

Switch on the DC-1 *SERIES 2* while holding down the ENTER key. The DC-1 will perform each test in turn, and you may move to the next test by pressing the ENTER key. Consequently, any test may be skipped by pressing the ENTER key.

Note: Whilst the SELF-TEST is in progress, the ENTER key will not initiate a MIDI DUMP.

ROUTINE 1:   BUTTON TESTING ROUTINE

The DC-1 *SERIES 2* will invite you to press each of the Function Keys (except ENTER) and each of the Dedicated Function Keys. Pressing a key will cause the display to change from OFF to ON.

ROUTINE 2:   ATTENUATION KNOB TEST

The DC-1 *SERIES 2* will invite you to turn the Attenuation knob to check that the value displayed on screen matches the position of the knob..

ROUTINE 3:   SPIN WHEEL TEST

Rotate the spinwheel to check that values change smoothly in both positive (clockwise) and negative (anti-clockwise) directions.

ROUTINE 4:   LED TEST

The DC-1 *SERIES 2* will flash all six green LEDs.

ROUTINE 5:   METER TEST

The DC-1 *SERIES 2* will invite you to turn the spinwheel to vary the levels displayed by each of the four input and output meters in turn. Press ENTER to step to the next meter.

ROUTINE 6:   DSP1 TEST

The DC-1 *SERIES 2* will test its DSPs and internal memory. Please wait for this test to complete.

•   If the System is fully functional the screen will display the message: **"Memory passed".**

•   If a memory error is detected the screen will display the message: **"Memory error at: .....".**

•   If a DSP failure is detected the screen will display the message: **"DSP1 is not responding".**

If you observe this message please repeat the self-test. If the message recurs, please contact your dealer for assistance.

WARNING: *The DC-1 SERIES 2 contains no user-serviceable parts. DO NOT UNDER ANY CIRCUMSTANCES attempt to service your unit.*

ROUTINE 7:   DSP2 TEST

As above.

TEST COMPETED

Your DC-1 *SERIES 2* will now prompt you to press ENTER one more time to return you to operating mode (whether all tests have been passed or not).

Some failures will not stop you from using the DC-1 *SERIES 2* successfully. However, you should notify your dealer or CEDAR Audio Ltd. if consistent failures occur.

CEDAR DC-1 *SERIES 2*

Designed and Manufactured by

CEDAR Audio Ltd
5 Glisson Road
Cambridge
CB1 2HA

Tel: & Fax: +44 (0)223 464117