



The S - DMX

Digital Audio System
user Manual

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S-DMX



OPERATING INSTRUCTIONS

System Overview

The S-DMX is a dual independent channel microprocessor controlled digital audio processor. It offers two completely independently delayed channels with precisely controlled delay times. The delay times are adjustable without any sacrifice in the 18kHz bandwidth which remains constant irrespective of the amount of delay selected. A total delay of over thirty two seconds is possible with this unit, split over the two channels.

The design is highly modular and software based, allowing incorporation of new technologies and techniques, therefore the system will not be rendered obsolescent as developments take place.

Memory back-up is supplied as standard to ensure that entries to the microprocessor are not lost on power down.

Both input and output levels are adjustable to accommodate units sending or requiring non-standard signal levels.

An intelligently spliced de-glitched pitch change is included and is incorporated on both channels. It will allow pitch shifting by as much as one octave either side of the original frequency.

Regeneration controls are provided on both channels of the S-DMX and the input may be switched to allow single line input (channel 'a' feeds both delay lines). A switch is also provided to allow the outputs to be mixed for special effects.

An important feature is the use of 'Nudge Buttons'. These buttons when used will cause the delay to sweep up or down in steps of only $25\mu\text{S}$ making the sweep virtually silent. Nudging of the pitch ratios and loop extremities is also available.

A facility for switching channel 'a' in phase or out of phase with the original and channel 'b' is provided.

A reset switch is provided for initialising the computer. A complete store clear instruction (D0) is also provided.

A flight case is available for the S-DMX if required. Flight cases which accommodate multiples of AMS Neve systems are also available.

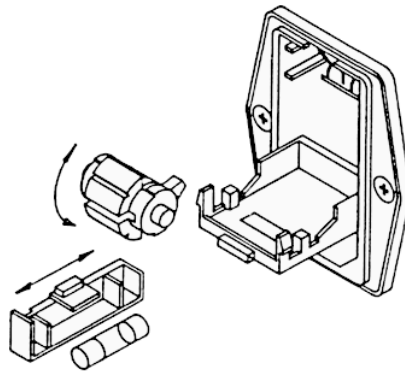
The unit is engineered to the same high standard as the rest of the DMX range and offers similar microprocessor controlled front panel facilities i.e. programmability, repeatability and storage capability not available with other forms of data entry, putting the engineer in complete control of the system functions.

The S-DMX is designed as a rack mounting unit 3.5"/2U high and 12.7" deep, excluding knobs and connectors. The choice of components and quality of construction are of a high standard and because of the choice of motherboard system with plug in circuit cards and ribbon cables, maintenance problems are reduced to a minimum.

Installation

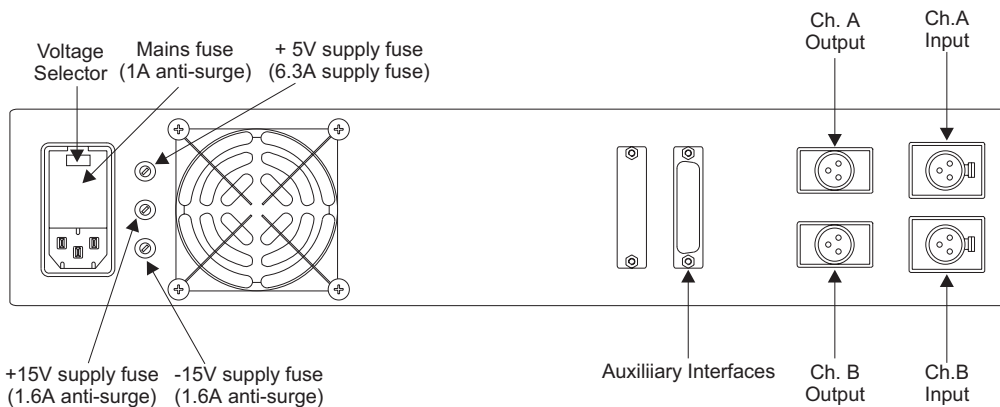
The model S-DMX can be operated with a line input voltage of 110, 220 or 240 Volts, adjustable externally. Before connecting the equipment to primary power, check that the line voltage setting is correct (see the voltage setting on the back of the unit): if the line voltage is not specified assume, for safety, a line voltage setting of 240 Volts. If it is found that the line voltage setting is incorrect use the following procedure to change it:

- Disconnect the mains lead from the unit.
- Insert a small screwdriver in to the slot at the top of the mains cover flap and lever open.
- Dropping the flap will give access to both the voltage selection barrel and the mains fuse.
- The voltage selector should now be removed and replaced so that the correct voltage setting is facing.
- Once the correct setting has been selected, the flap should be replaced.
- The mains lead may now be replaced.



The outputs of the S-DMX are balanced electronically and are compensating. This means that the output behaves effectively as if it were transformer supplied. For unbalanced operation, the unused output pin should be grounded.

The connections to the rear of the unit are as follows:



Mains Wiring

All mains leads supplied with equipment manufactured at AMS Neve are wired in accordance with the European (I.E.C.) colour code. The code is as follows:

BROWN	LIVE
BLUE	NEUTRAL
GREEN/YELLOW	EARTH

Fuse Replacement

All power supply rails within the S-DMX are protected by current limiting and also against over voltage. If for any reason the voltage on a particular rail exceeds certain limits, a thyristor connected across that power rail is activated, blowing the fuse and protecting the unit's electronics. It should be noted that this may (very occasionally) happen when no fault is present, but a sharp and possibly dangerous mains surge has occurred. There are four fuses contained within the S-DMX. All of which are immediately accessible on the rear panel of the unit.

Spare fuses are included in the package of goods sent with your unit. If replacement is necessary ensure that the correct fuse is used; markings on the rear panel indicate the type and rating of each fuse in use.

Operation

Input / Output Level And Mixing Section

The input may be switched between two channel operation (stereo input) and single input, dual output operation (mono input using channel 'a' as source). The two outputs may also be mixed if desired to create or enhance various effects. If the input is two channel and the outputs remain unmixed the stereo LED will illuminate to indicate true stereo operation.

The output level control is a ganged control which governs the output of both channel 'a' and channel 'b'. After the input levels have been set for the best working conditions this control should be adjusted to give a good level match on the mixing desk.

Input Level Control Section

Individual input signal levels can be varied using the two input control knobs, an indication of the signal levels is given by 'traffic signal' light emitting diodes (LEDs). The red LEDs are illuminated 6 dB before clipping, the yellow LEDs 12 dB and the green LEDs 18 dB. In normal operation, with a signal present the input levels should be adjusted so that the green LEDs are illuminated all the time, the yellow LEDs most of the time and the red LEDs illuminate only when the highest programme peaks occur.

A proportion of the output of a channel may be fed back to that channels input by adjustment of the respective regenerative control knob.

VCO Control Section

Channels can be varied using the two input control knobs, an indication of the signal levels is given by 'traffic signal' light emitting diodes (LEDs). The red LEDs are illuminated 6 dB before clipping, the yellow LEDs 12 dB and the green LEDs 18 dB. In normal operation, with a signal present the input levels should be adjusted so that the green LEDs are illuminated all the time.

The Dual Lock In Function

The S-DMX incorporates two independently controllable loops, which may also be driven in 'single shot' mode by the keypad, audio triggered by their respective inputs and the keyboard interface allows 'playing' of loop A in real time.

The audio is locked in by throwing the 'lock in' switch for the appropriate channel. (The Ch.A in/out phase switch is used for Ch.B. lock in.) The message 'Loc.A' or 'Loc.B' will then be displayed to acknowledge the capture of audio in the respective channels A and B.

For the loop in Ch.A the current time into the loop of the start point is displayed by pressing the A key on the keypad. A second depression of A will then display the time into the loop of the selected end point. The display is identified by the two LEDs to the right of the numeric display. The red LED marked '^' indicates that the start of the loop is being displayed, the green LED marked 'v' that the end is being displayed. Exactly the same procedure is followed for Ch.B, using the B key instead of A.


The captured audio is looped by pressing the 'D' key and will loop the channel that is currently selected. The display LP-A or LP-B will appear to advise the operator of this function.

The selected channel may be 'fired off' in single shot mode by pressing the enter key '#' and may be repeatedly triggered by multiple depressions. The message 'tr.-A' or 'tr.-B' will appear.

The pitch of the loop may be varied in a similar way to normal operation by pressing the 'C' key after the appropriate channel selector 'A' or 'B'. A pitch may then be entered via the keypad or the nudge controls used. The nudge controls may also be used to select start and finish points for the loop, but operate slightly differently from normal mode, in that as the button is held down, the nudge increments becoming progressively greater. Releasing the button then re-depressing, starts the process again from 1 mS increments.

The loops may also be 'fired off' by applying to the input of the appropriate channel a signal whose envelope is sufficient to just illuminate the green level LED for that channel.

Whilst one channel is in lock in mode, the other may be used as normal for delay / pitch change, or may be locked-in also.

 Once the desired sample has been 'locked-in', in order to avoid constant re-triggering of the loop either remove the input to channel 'a' or return the channel 'a' input level control to zero.

Editing with the keypad

To remove a portion from the beginning of the loop first press the 'A' key. When the 'A' key is pressed the present starting point of the loop is displayed. Now enter the new start point in milliseconds; the 'a' channel identifier LED will flash until the splice point has actually been entered (i.e. until the # key has been pressed).

To remove a portion from the end of the loop first press the 'B' key. When the 'B' key is pressed the current 'loop end' position will be displayed. The new loop end point must now be keyed in again in milliseconds; the 'b' identifier LED will flash until the enter key # is pressed.

Editing using the nudge keys

Editing can also be accomplished by using the nudge keys. The nudge keys allow the ends of the loop to be incremented as well as decremented. This is a quick way of 'fine tuning' the loop before use, it should be noted however that during the nudging process some audio interference will occur.

Other effects

If the 'C' key is pressed it is possible to vary the pitch of the loop. The effect obtained can be likened to using varispeed on a tape loop system. This may be accomplished by direct entry, using the keypad, or by use of the nudge buttons. Unlike nudging the ends of the loop, nudging pitch does not cause audio interference.

When in 'Lock in' mode, with software versions 2.464 upwards, if stereo pitch shift is fitted and input on both channels, the nudge controls shift the pitch at the output in opposite directions.

This can be used to correct the pitch of the loop in channel 'a' by routing channel 'a' output to channel 'b' input. The sample at channel 'b' output will then be shortened or lengthened by the varispeed function, but with the original pitch retained.

The loop may also be read out on a 'one-shot' basis. This is accomplished by pushing the # key. After the # key has been pressed the edited loop will be read out once and will not be read out again until the # key is pressed again. The loop may now be read out continuously by pressing the 'D' key.

The loop may also be audio triggered. In this case the 'locked in' audio will be read out if an audio signal of sufficient level to illuminate the green LED is applied to channel 'a'.

Cautionary Notes

Having come out of the lock-in mode, there is no point re-entering until the maximum 'tape loop' time has elapsed. If re-entry prior to this is attempted the resulting audio signal will contain a mixture of the previously locked loop and new audio data.


DO NOT switch the power on with the lock-in function selected as random data in the RAMs will be locked in and sent to the audio chain at a high level.

Reverse Loop

Reverse loop is achieved by typing the end stop value at the beginning of the loop and the start point value at the end of the loop.

Example:

For a unit containing 6.4 seconds of lock after the initial throwing of the lock switch, the unit displays the word LOT. Entering A # will cause the unit to display 6.400 (or maximum value of lock for that particular channel). At this point 0 should be entered. Pressing the A key again will result in the display still reading zero but LED mark ^ will be illuminated, 6.400, or whatever value required, should now be entered. The unit is now in reverse loop mode and can be triggered as before, that is, with the audio trigger or the hash key. It should be noted, however, that there is no provision for pitch change while the loop is in reverse mode.

 *If the start time entered is greater than the end time there will be no output.*

'In Phase / Out' Switch

When the 'in phase/out' switch is depressed the output of channel 'a' is out of phase with the input, a useful device for creating various 'tunneling' effects if used in conjunction with the re-generative controls, the nudge controls and the output mix switch.

Nudge Controls

Altering delays

The nudge buttons may be used to edge the selected delay up or down, an indication of the direction is given by the LEDs to the right of the display. These buttons when used change the displayed delay, and also the value in the respective store location, by approximately 2mS/Second in 25µS steps producing a smooth, virtually silent change in the delay time.

Pitch shifting

The nudge buttons may also be used for pitch shifting and are most effective for pitch searching and tuning.

Loop Editing

When in the lock in mode the nudge buttons may also be used for loop editing. In this case the beginning and the end of the loop may be adjusted (i.e. increasing or decreasing the length of either end of the loop is possible, within the limits).

Pitch shifting in the lock in mode is also possible; the effect obtained can be likened to varispeed on mechanical tape loop systems.

Computer Control

Computer control is effected by the use of the keypad:

Keys A and B

These select the audio channel to be processed either A or B, depressing either will cause the delay setting for that channel to be displayed (in milliseconds) and the relevant identifier LED immediately below the display to be lit (A or B). These keys are also used for loop editing in the lock in mode.

Key C

Pressing the 'C' key after selecting the appropriate channel (A or B) results in the pitch ratio information being displayed and allows the operator to change the pitch of the signal. In this case LED 'C' glows in addition to the channel identifier LED A or B.

Keys 0 - 9

Keying in a delay setting will cause entry into the display only and will not affect the programme until the data is entered into the unit by depressing the # key. Until the # is depressed the channel identifier LED will flash indicating temporary data. The display only reflects the contents of the DDL once the # key has been depressed and the channel identifier LED has stopped flashing.

Key *

This key is used for decimal point entry when using the pitch shift and delay selection in excess of one second.

Key D


Depressing this key causes the current store number to be displayed in the format 'Str.5'. To change the current store a single numeral is typed in the range 1 to 9. No enter keystroke (#) is required, the system will immediately enter into the delays and pitch change settings programmed within that store and all subsequent entries will be retained in that store. If instead of a numeral, A or B is then depressed the system will display the delay contents for that channel (see above) and store will remain unaltered. If the '0' key is pressed immediately after the 'D' key then all of the store locations will be cleared - so be careful.

Key #

This is the 'Enter' key which must be depressed to enter a delay into the unit. It is also used for single shot looping whilst in the lock in mode.

General

If more than four numeric characters are typed, or the user attempts to enter a delay, outside the limit of the unit an error message 'Err' will be displayed to warn the operator. The correct entry may then be typed.

 *The above refers to normal operation mode. See 'The Dual Lock In Function' section for special use.*

Power Switching and Reset

When the unit is first switched on or if 'reset' is depressed the unit will be initialised.

Initialising the unit does not clear any of the store locations. It does however re-start the microprocessor and therefore the display and the output will reflect the contents of the last store location selected and also the last function selected.

If you wish to clear all of the store locations simply key 'D' then '0'.

Using the S-DMX

Back To Basics

A digital delay line (DDL) as its name implies, is a device that receives a given signal at its input and after a defined lapse of time (programmed by the user) reproduces that exact same signal at the output. The DDL, as in the case of the S-DMX, should not alter or modify the signal no matter what delay is programmed. The S-DMX has two such delay lines which are independently programmable.

The output of channel 'a' can be switched in phase or 180 degrees out of phase with the original signal whilst the output of channel 'b' is always in phase with the original.

The S-DMX, as stated above, does not modify the signal when applying a delay. However, re-generative effects and VCO or vibrato effects can be introduced if required by adjusting the relevant controls on the front panel.

It is obvious that a great deal can be accomplished using the S-DMX besides simple delay, and the following paragraphs have been written to help the studio engineer get the best possible use from the unit.

Original Settings

With the power switched on and a signal present ensure that both input level control knobs are set correctly, i.e. ensure that both regen control knobs are set to zero and adjust the input level control knobs so that the red LEDs illuminate on programme peaks only. The output control knob should be adjusted to ensure a good match between the unit and the mixing desk. The following should now be set as indicated:

'in sep./mix'	to in sep.
'out sep./mix'	to out sep.
'VCO speed and depth'	controls to zero.
'regen'	controls still set to zero.
'norm/lock in'	switch to norm.
'chan.a in phase/out'	switch to chan.a in phase.
'xtal./vco'	switch to xtal.

Switch On:

When power is switched on, the computer is initialised and the output of the unit is governed by the last store location selected and also the last function selected. If the 'D' key is pressed followed by the '0' key all store locations will be cleared. In real terms this means that outputs 'a' and 'b' will occur effectively in synchronisation with their input signals until a delay is keyed in. Also, the display will reflect the contents of channel 'a' store 1 and therefore the channel identifier LED 'a' will be illuminated. If the 'D' key is pressed Str.1 will now be displayed indicating that the outputs are governed by entries in this store location; if now the 'B' key is pressed zero will be displayed indicating no delay on channel 'b', the 'A' key should now be pressed the display will again show no delay on channel 'a'.

Channel 'a' Delay

To delay the output on channel 'a' with respect to the original, enter the required delay (in milliseconds) into the display via the keypad. The 'a' channel identifier LED will now flash, indicating temporary data in the display, until the data is entered into the store by depressing the # key. Immediately it is entered into the store location channel 'a' will be delayed with respect to the original by the amount programmed and the 'a' LED will stop flashing. If the user attempts to enter a delay outside the limit of the unit an error message 'Err' will be displayed to warn the operator; the correct entry may then be typed.

Channel 'b' Delay

To delay the output of channel 'b' with respect to the original, first depress the 'B' key. The 'b' LED will now illuminate indicating that the display now reflects the contents of channel 'b'. To delay the output, follow the procedure as outlined for channel 'a'; this time the 'b' LED will flash until the # key is depressed.

Storing Delays

If the 'D' key is depressed, the display will indicate the current store in use (at the present store 1, 'Str.1').

Let us say that we do not wish to lose the effects of the delays, and perhaps pitch changes, entered in channels 'a' and 'b' but wish to try a longer delay, say on channel 'a'. to see what effect this will have. If the '2' key is depressed immediately after the 'D' key, the outputs will now be governed by the contents of the second store location (Str.2; zero at present). We can now enter the same delay for channel 'b' and the longer delay for channel 'a' in Str.2. We now have a combination of delays in two store locations; there are nine store locations in all, therefore nine different combinations may be tried if so desired. To compare the different settings all we need do is keep the 'D' key depressed whilst keying through the store locations 1 to 9.

This ability to store different settings, and also the ability to instantly recall a setting, is very useful for the Studio Engineer and Producer alike. For example, let us say that during a session the Producer asks for echo on vocals during the verse of a song, but during the chorus he would like to reduce this to a close double tracking effect. Possibly a guitarist wishes to have a 'distant' sound during the vocal parts of a song but during the solo he would like a 'dry' sound. Both of the above are readily accomplished using the S-DMX.

The case above is taken for simplicity, obviously the S-DMX is far more flexible than the example shows; the example is only used as a guide to the techniques involved.

Mixing

When using the S-DMX alone, mixing of the two delayed channels can be accomplished by use of the output mix control on the front panel of the unit. A much larger variety of effects are attainable when using the S-DMX in conjunction with a mixing desk since the original signal may also be mixed with the outputs of the delay lines.

ADT

Automatic Double Tracking is improved if the secondary signal is varied in pitch by a small amount. This can be accomplished by adjustment of the vco controls or by incorporation of the pitch change option.

When using the vco section to improve ADT remember that the pitch variation is dependent upon both the vco speed and depth control settings, and also the delay times between the original signal and the outputs of the unit. To obtain this improved ADT effect first switch the 'xtal./vco' switch to vco. For an ADT setting of 18mS the best effect is obtained by setting the depth control to '9' and the speed control between '2' and '3'; as the delay setting is increased however, the depth setting will have to be decreased to retain a reasonable ADT effect.

VCO

The vibrato effect created by the vco can if used properly, enhance the effect of certain instruments and is a useful tool in its own right.

Controlled Flanging

The following method can be used if flanging is required using the S-DMX outputs alone.

First return all the front panel controls to their 'original' settings. Now switch the 'out sep./mix' control to mix; if now the nudge buttons are used around zero delay, flanging should be audible.

By using the mixing desk other methods can be employed to achieve flanging using the basic principles outlined above.

The Dual Lock In Function

As mentioned in the earlier 'Operation' section when the 'lock in' switch is thrown the word LOC will be displayed and the contents of the 'A' channel delay line at that instant will be locked in.

By using the 'lock in' facility the loop on channel 'a' may be edited.

As an example we have chosen to remove 100mS from the beginning and end of a loop. We have chosen a loop size of 1.638 Seconds and have assumed for clarity that no previous editing has been done.

Editing with the keypad

To remove 100mS from the beginning of the loop first press the 'A' key. When the 'A' key is pressed the present starting point of the loop (i.e. 0) will be displayed. Now enter the new start point in milliseconds (i.e. 100); the 'a' channel identifier LED will flash until the splice point has been entered by pressing the # key.

A loop start point of zero can now be entered via the keypad. Once the loop start point has been set away from zero the lowest time entry via the keypad is 1mS. The nudge buttons may be used to enter zero if so desired (see below).

To remove 100mS from the end of the loop first press the 'B' key. When the 'B' key is pressed the current 'loop end' position will be displayed. The new loop end point must now be keyed in again in milliseconds (i.e. 1503). The 'b' identifier LED will flash until the enter (#) key is pressed.

Notice that the end of the loop is 35mS less than the RAM storage size would suggest (in our case 1.603 Seconds and not 1.638 Seconds). This is the amount of time taken to complete the splicing operation. In fact, after entry of a start or finish point for the loop the high speed microprocessor analyses the frequency and amplitude content of the subsequent 30mS for two suitable splicing points to enable the join to be as free from interference as possible. the actual splice points may be slightly different from those displayed, and incrementing the start and finish points by only a few milliseconds may have no effect.

Editing using the nudge keys

Editing can also be accomplished by using the nudge keys. The nudge keys allow the ends of the loop to be incremented as well as decremented in steps (see earlier 'Operation' section).

For other effects and a few cautionary notes on the operation of the 'lock in' function (see 'Operation' section).

The Pitch Change

Pitch Change is available on both channel 'a' and channel 'b' and therefore the following notes will apply to both channels. Remember that any effect selected using the 'C' key will always be in addition to the programmed delay, and also that an inherent effect of the pitch shifting process is an inbuilt delay which varies continually.

Programming Pitch Change - Channel 'a'

First set all the controls to the 'ORIGINAL SETTINGS' outlined in the 'Original Settings' section and press the 'D' key followed by the '0' key. Now depress the 'C' key, both the channel 'a' LED and the 'c' LED will illuminate and the display will read 1.000 indicating a pitch ratio of one i.e. no change in pitch from the original, or 'unison'. The lowest pitch available is an octave down from the original, that is half the original frequency or a ratio of '0.500'. To obtain this depress the '*' key followed by the '5' key, the display will now read '0.5' and the 'a' and 'c' LEDs will flash indicating temporary data in the display. Entering this ratio by depressing the '#' key will cause the 'a' and 'c' LEDs to stop flashing and the display to read '0.500' indicating an octave decrease in pitch on channel 'a'. If we now look at the contents of channel 'a' (this is accomplished by depressing the 'A' key) the letter 'H' will be flashing on the left of the display indicating that the original and output 'a' are not in unison. If a delay is now required on channel 'a' it can be programmed in exactly the same way as in the 'Channel 'a' Delay' section.

The highest pitch available is an octave increase in the original, that is twice the original frequency or a ratio of 2.000, and can be programmed by depressing the 'C', '2' and '#' keys respectively.

Pitch ratios of less than half or greater than two are not programmable and if tried an error (Err) message will be displayed to warn the operator of his mistake. Pitch changes between these two extremes are programmable to three decimal places.

The 'Nudge' buttons can be used to alter the pitch up or down and are most effective for pitch searching and tuning.

Programming Pitch Change - Channel 'b'

This is achieved exactly as for channel 'a' except that the 'B' key must be depressed prior to programming the pitch ratio. In this case the 'b' and 'c' LEDs will flash until the pitch ratio is entered.

Understanding and Using The Pitch Changer

The AMS Pitch Changer employs a very fast microprocessor which examines the digitised musical signal within the memory and performs a number of tests to isolate two points in time which have the highest correlation with each other in terms of waveshape. The pitch shift algorithm contained in the program memory uses this information in conjunction with the required pitch ratio to minimise the 'glitch' problem normally associated with real time pitch changing. With suitable programme material almost perfect pitch shifting can be obtained without the characteristic 'fluttering' of other units on the market. For very different programme material and very wide pitch ratio settings, the performance can be further enhanced by fitting the de-glitch option. The wide bandwidth and excellent noise performance of the basic delay function is also retained when changing pitch, as is the vco facility. Combining all these features, and the ability to key in a pitch ratio of crystal-locked stability means the engineer may create automatic double tracking of hitherto unobtainable quality and effectiveness. In certain cases, feedback enhances the 'fullness' of the sound.

Feedback, used with care, can be used to great effect; for instance, at a pitch ratio of 2.0 feed-back generates harmonics of the input, and single notes on a bass guitar for instance can be made to sound as if they were played on an organ. Chords, or beat frequencies between two notes on the bass guitar will make it impossible for the microprocessor to identify the frequency of the incoming signal, and will cause the effect to be marred. Nevertheless, the lack of the usual 'wobble' on the output means that it is now possible to use a pitch changer musically at pitch ratios other than 1.01.

Notes

1. Interesting arpeggio effects can be obtained by programming delays longer than 200-300mS and applying feedback to just short of instability. This effect is especially useful if musical intervals are programmed as the pitch shift, such as 1.26. When applying feedback whilst pitch changing, care should be taken when shifting the frequency down by significant amounts, since if instability is reached successive cycles of feedback will cause any input frequency to tend towards zero. On the way, the output will pass the resonant frequency of most things in the control room, including the engineers and the monitors - so BEWARE!

2. The unit performs at its best on programmed material with recognisable pitch and amplitude; material with high elements of attack does not allow perfect splicing, since two compatible points in the memory do not exist. However, as mentioned above, the de-glitch option will significantly improve the performance under these circumstances.

3. In an attempt to ensure that all S-DMX users are familiar with 'pitch ratio', not only as an effect but also as a musical tool, we have included the following data. We have done this knowing full well that most of the people who are reading this manual will already be familiar with the theories expounded below. However for those who are uninitiated the following may help:

Each note in the chromatic scale is separated from the next by a semitone increase in pitch; the lowest common musical interval. This semitone increase is not a fixed frequency. If for example we move from A' to A#' we will need to increase the frequency by 26Hz to effect a semitone increase in pitch. If we now add 26Hz to G#' we will not arrive at A". To move from G#' to A" we will need to add 49Hz to effect the same semitone increase. This is because the semitone is a frequency ratio or pitch ratio and is therefore dependent on the frequency of the note being played.

The pitch ratio has the following geometric progression:

$(\sqrt[12]{2})^n$ where n is the number of semitones above unison. Let us see the chromatic scale of A' as our example:

Note	Fundamental (Hz) x Pitch Ratio	Frequency (Hz)	Frequency Increase
A'	$440 \times (\sqrt[12]{2})^0 = 440 \times 1$	440	26.1638
A#'	$440 \times (\sqrt[12]{2})^1 = 440 \times 1.059463$	466.1638	27.7195
B'	$440 \times (\sqrt[12]{2})^2 = 440 \times 1.122462$	493.8833	29.3678
C'	$440 \times (\sqrt[12]{2})^3 = 440 \times 1.189207$	523.2511	31.1141
C#'	$440 \times (\sqrt[12]{2})^4 = 440 \times 1.259921$	554.3652	32.9644
D'	$440 \times (\sqrt[12]{2})^5 = 440 \times 1.334840$	587.3296	34.9244
D#'	$440 \times (\sqrt[12]{2})^6 = 440 \times 1.414214$	622.2540	37.0011
E'	$440 \times (\sqrt[12]{2})^7 = 440 \times 1.498307$	659.2551	39.2014
F'	$440 \times (\sqrt[12]{2})^8 = 440 \times 1.587400$	698.4565	41.5324
F#'	$440 \times (\sqrt[12]{2})^9 = 440 \times 1.681793$	739.9889	44.0020
G	$440 \times (\sqrt[12]{2})^{10} = 440 \times 1.781798$	783.9909	46.6185
G#'	$440 \times (\sqrt[12]{2})^{11} = 440 \times 1.887749$	830.6094	49.3906
A	$440 \times (\sqrt[12]{2})^{12} = 440 \times 2$	880	

It is important only that you remember the relevant pitch ratios since the fundamental frequency can be any value; these are summarised below:

Chromatic Scaling	French Name (Tonic Solfa)	Pitch Ratio
unison (1)	Do	1
2		1.059
3	Re	1.122
4		1.189
5	Mi	1.260
6	Fa	1.335
7		1.414
8	So	1.498
9		1.587
10	La	1.682
11		1.782
12	Te	1.888
octave (1')	Do	2

To obtain the familiar Do, Re, Mi, Fa, So, La, Te, Do (the major scale) we are all so conversant with; first feed in a constant signal, possibly a sine wave, to the pitch change channel ensure that the pitch ratio in store 1 is 1. Now set store 2 to 1.122, store 3 to 1.26, store 4 to 1.335 etc., etc., culminating in entering 2 in store 8. If we now return to store 1 and keep the 'D' key depressed whilst thumbing through the eight store locations in sequence the major scale will be audible.

The above can be modified to suit any scale characteristics and is only restricted by the operators imagination.

THEORY OF OPERATION

Overall Functional Description

The balanced inputs to the unit are fed to the input cards which process the signals into unbalanced form, these signals are then fed through low pass filtering to prevent aliasing components appearing at the outputs of the unit. Buffered drive signals are then fed to the input level controls on the front panel and the outputs from these front panel controls are fed to preset gain stages on the input cards, the outputs of which are fed to the stereo sampler card.

The stereo sampler card accepts the outputs from the input cards together with the feedback signals and mixes them into balanced stages to avoid common mode interference pickup. Each channel is fed to a monolithic sample and hold device. These devices are strobed in antiphase at a sampling rate of 40kHz with the crystal switched in, but variable on vco. The outputs of these are fed to a comparator/gain switching section alternately by means of a FET switch. The signal is then scaled by 1, 2, 4 or 8 to optimise the signal to noise ratio, and a two bit exponent number is generated to note the scaling factor used. The signals for driving the 'traffic signal' LEDs for channel 'b' are also derived from this board.

Control and timing signals for this board are derived from the memory control board, the clock inputs being generated by either the crystal oscillator or the voltage controlled oscillator (vco). The ADC conversion command is then decoded, and the resulting response, 'conversion complete' is used to control the latching of the correct exponent for that sampling period.

The sampled analogue output from the sampler card is fed into the ADC via a buffer amplifier. Timing signals from the sampler card cause a conversion to be initiated. The twelve-bit result is latched into a set of registers/data highway drivers for storage in memory. The level indicating drivers for channel 'a' are also located on the ADC card. The vco is also generated on the ADC card by first generating a triangular waveform whose frequency is varied by the vco speed control on the front panel. This triangular waveform besides feeding the drive circuitry for the vco speed LED, also feeds a shaping chip which generates a sine wave. The sine wave is buffered and fed to the vco depth control on the front panel; the output from this is then mixed with a preset d.c. voltage and is fed to the voltage controlled oscillator. The d.c. voltage thus gives the nominal output frequency of the vco, the amplitude of the sine wave gives the range of swing (depth) from the nominal frequency, and the frequency of the sine wave increases and decreases the rapidity of the swing (speed). The vco has the effect of altering the sampling rate.

The memory control card provides timing signals for the random access memory (RAM) array and also controls which addresses in the in the array are written to and read from. These addresses are loaded into the memory control board by the pitch changers via ribbon cables.

In each sampling period, the following sequence occurs:

1. Write channel 'a' data into RAM.
2. Read channel 'a' data from RAM address offset 'A', into DAC A.
3. Convert channel 'b' / sample channel 'a'
4. Write channel 'b' data into RAM.
5. Read channel 'b' data from RAM address offset 'B', into DAC B.
6. Convert channel 'a' / sample channel 'b'.

Delays are altered by changing address offsets 'A' and 'B'.

The RAM card address lines are multiplexed, and the current RAM card being accessed is selected on the baseboard as a result of the four highest address bits from the memory control board and the channel selected (0=A, 1=B).

Each 256k RAM card is used to retain 262 144 samples of the analogue signal in the form of 12 bits of amplitude data (mantissa) and two bits of range data (exponent). At the normal sampling rate of 25 μ S per sample, this corresponds to a delay of 6.55 Secs. Apart from the RAM devices themselves, the card provides data highway buffering and write control enabling when the card is selected.

The digital signal from the RAM is converted back to analogue form on the DAC boards (2 off: one for channel 'a' and one for channel 'b'). These cards accept the 'mantissa and exponent' digital input, perform shift left operations on the mantissa dependent on the value of the exponent (multiplication), and reconstitute the original signal by means of the DAC device on each board. The DAC outputs is buffered and filtered to remove sampling steps and fed to the baseboard, then to the output controls, the outputs of which are fed back to the DAC cards where the balanced outputs are generated.

The interface with the pitch changers, the keypad, the display, the storage of preset values, the 'Nudge' button controls, the status LED controls and all parameter calculations are performed by the microprocessor board. This board holds the 8085 microprocessor, 2kByte of Programmable Read Only Memory (PROM); 2k Bytes of CMOS RAM with battery back-up and two programmable I/O devices.

The basic back wiring of the unit is accomplished by the use of a mother board or baseboard. This board contains all the power supplies for the unit together with the buffer amplifiers and steering logic.

The supplies are as follows:-

Voltage	Current Rating
+5V	6A
+15V	1A
-15V	1A
+12V	0.5A
-5V	0.5A

Communication to and from the central processor is accomplished via the display board which contains the drive for the 7 segment display together with the display itself and the 'Nudge' buttons. It is driven by I/O ports on the microprocessor board and is connected by ribbon cables.

MAINTENANCE

General Maintenance

Access

All printed circuit board assemblies can be accessed by removing the top cover plate, five DZUS fasteners hold the plate in place. To loosen the DZUS fasteners a 90 degree anti-clock-wise rotation is all that is required. For cleaning purposes it will also be necessary to remove the bottom plate. The bottom plate is held on by four DZUS fasteners. The front panel is affixed by four M5 x 12mm countersunk socket head screws (black) and can be removed using a 3mm AF Allen key. The display board is held on to the front panel by three M3 x 20mm countersunk socket head screws (black) together with three 9mm spacers, washers, shake proof washers and M3 nuts. The fan and the fan guard are also held on by four M5 x 10mm Pan Head Posidrive screws.

Cleaning

The S-DMX should be cleaned periodically to remove dust, grease and other contaminants. The surface of all the printed circuit boards should be cleaned using dry air at low pressure (psi). If grease is to be removed use Arklone F or Freon TF and remove grime with clean dry air at low pressure. Clean the front panel with a soft cloth dampened with a mild solution of detergent and water. **DO NOT USE ARKLONE or FREON ON THE DISPLAY FILTER** as this will cause damage.

Only high quality, heavily gold-plated edge connector blades and edge socket pins are used and problems in this area are unlikely to occur. It is extremely important that chemical contact cleaners are not used on these blades. This type of cleaner results in gross contamination of the edge pin sockets that cannot be removed without replacing the socket itself. If you suspect problems in this area, then, as a last resort only, use a rubber to clean the edge blades in question.

Battery Replacement

It is recommended that the 3.6V mepac battery (AMS Neve Part No. 330-164) on the microprocessor card (SUN820-053) is replaced every two years. After replacing the battery reset the unit by pressing 'D' then '0'.

Trouble Shooting

Before embarking on the checking procedures outlined below, ensure that all the power supplies are at their correct potential and that all the fuses are intact; also check the input wiring external to the S-DMX for shorts.

Possible causes are listed in order of probability and therefore should be checked in strict order.

SWITCH THE POWER OFF WHEN REMOVING OR INSERTING BOARDS and please take extreme care in ensuring that the cards are replaced in the correct slot with the correct orientation.

If you are not sure, please contact AMS Neve or your nearest service representative.

Symptom	Possible Cause
All level LEDs on permanently.	-15V supply fault: Check - 15V fuse.
Loss of output on one channel only with input LEDs not functioning for that channel.	1. Input short circuit on inoperative channel: Check input cable then the internal wiring of the unit. 2. Swap input cards.
Loss of output on one channel only with input LEDs functioning correctly.	1. Output short circuit on inoperative channel: Check output cable then the internal wiring of the unit. 2. Swap the DAC cards.
Unit giving glitches at regular intervals on one channel only.	Possible defective RAM card: swap RAM cards with other channel.
Displays showing random data.	possible fault on +5V supply rail: monitor +5V rail.
Intermittent output on one channel.	Faulty RAM board.
Constantly distorted output.	1. DAC board: distortion will be isolated to associated channel. 2. ADC board. 3. Input board: distortion will be isolated to associated channel.

SPECIFICATIONS

Electrical

Input Impedance (Zin):	10kW : Electronically balanced.
Input Sensitivity:	10 dBV : Ref. 0.775 Volts.
Inputs:	Two independent inputs.
Maximum Gain:	20 dB.
Output Impedance:	150Ω : Compensating Electronically balanced.
Maximum Output Level:	+ 20 dBV.
Outputs:	Two independent outputs.
Distortion:	Less than 0.035% at 1 kHz; full output.
Dynamic Range:	90 dB / 15 bit equivalent.
Frequency Response:	20 Hz to 18 kHz : -3 dB, + 0 dB.
Input connectors:	Two XLR-3-31 (female).
Output connectors:	Two XLR-3-32 (male).
Power consumption:	80 VA maximum.
Power requirements:	110/220/240 VAC: adjustable.
Power connector:	Standard IEC mains connector.

Nudge:



Nudge control resolution:	25μs.
Nudge rate (approximate):	2ms / Second.

VCO:

VCO control (speed):	0.05Hz to 20Hz.
VCO frequency shift (depth):	0 to 20% continuously variable.

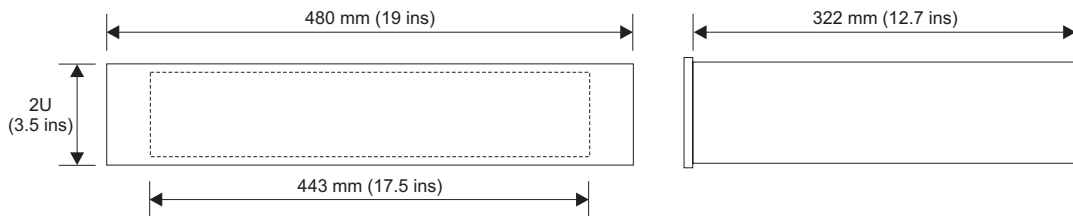
Computer Control:

- Time Entry: By numeric keypad; least significant digit = 1 ms.
- Display: 7 Segment digital readout of selected delay time or pitch ratio.
- Memory: 9 Memory locations capable of storing 'a' and 'b' entries of delay and pitch change.
- Reset: The computer is initialised when this is depressed.

-  The computer is also initialised on switch on.
-  As the units are regularly updated to provide new functions and take advantage of newer technologies, these specifications are subject to change without notice.

Dimensions

U	Width mm (inches)	Depth mm (inches)	Height mm (inches)	Approx. Weight kg (lbs)
2	480 (19)	310 (12 ³ / ₄)	89 (3 ¹ / ₂)	11 (24)



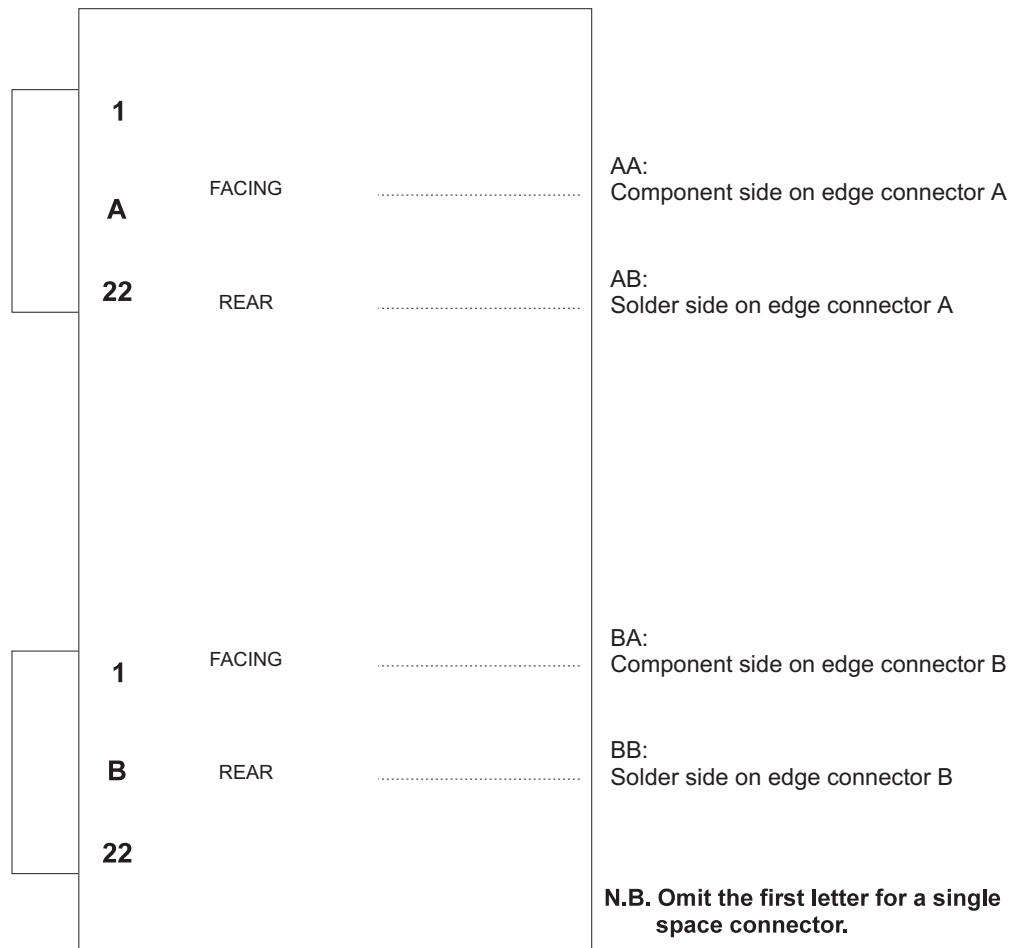
Options

- Channel A / B 6.5 / 6.5 seconds
- Channel A / B 13 / 6.5 seconds
- Channel A / B 13 / 13 seconds
- Channel A / B 19.5 / 6.5 seconds
- Channel A / B 26 / 13 seconds
- Channel A / B 26 / 26 seconds

APPENDIX A

Board Edge Connector Details

With component side facing and the edge connectors on the left the following applies:



APPENDIX B

Set-Up Procedures for MIDI Equipped S-DMX

1. The 25 way D-type to 5-pin adaptor must be plugged in before the unit can be set-up.
2. Hold the D-key on the keypad down and reset the unit.
3. The display will read 'SET'.

Assigning a Midi Channel to the S-DMX

4. S-DMX channel A and B are selected by pressing the corresponding button on the keypad. The display will read 'A=nn' or 'B=nn'; nn being the midi channel number already selected.
5. Ch A and B can be set to any of the 16 midi channels available. Key in the desired channel number and press enter, normally channel 01 with keyboards. An invalid number will give an error message on the display. Press enter again to get back to step three.

Calibrating the pitch ratio to the keyboard

6. Press the C-key on the keypad and then the A key. Channel A will then be ready for calibration. The A and C indicating LEDs now light up and CAL is displayed.
7. Press middle C on your keyboard and the S-DMX display will read '1.000', Press the ENTER key.
8. Press the C key on the keypad followed by 'B'. Channel B will then be ready for calibration. The B and C indicator LEDs then light up and CAL is displayed.
9. Press middle C on your keyboard and the S-DMX display reads '1.000'. Now press the ENTER key twice.

NOTES

- (a) The parameters assigned to the S-DMX are retained on power down.
- (b) Both channels can be considered as being fully independent of each other and can be used in or out of lock in and with audio trigger at will.
- (c) When a channel is being driven by midi the input gain pot should be wound down to minimum to avoid false triggering.
- (d) The midi channel no. can be re-assigned at any time to provide a means of calibrating the pitch and then allowing that channel to be driven via a sequencer if required.
- (e) Each channel can be pitch shifted up or down 1 octave, any key out of range will default to 0.500 or 2.000.
- (f) When the unit is to be operated in lock in, the midi parameters must be set-up prior to capturing a sample.

