DMX 15-80 S : Digital Delay / Pitch Shifter

User Manual

Issue 1

As part of our policy of continual product improvement, we reserve the right to alter specifications without notice but with due regard to all current legislation.

Disclaimer: The information in this manual has been carefully checked and is believed to be accurate at the time of publication. However, no responsibility is taken by us for inaccuracies, errors or omissions nor any liability assumed for any loss or damage resulting either directly or indirectly from use of the information contained within it.

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AMS DMX 15-80 S Product Overview

Create Soundscapes and Textures with a Rare Vintage Digital Delay

Introduced in 1978, the AMS DMX 15-80 S was the world's first microprocessor controlled, 15-bit digital delay and pitch shifter. Used on classic albums by Joy Division, Nirvana, Brian Eno, and many more, the AMS DMX is famous for adding its iconic '80's-era space and depth.

An Era-Defining Studio Processor

Upon its introduction, the AMS DMX was hailed as a digital wonder. Featuring two independent delay channels, just over six seconds of delay time, and groundbreaking "de-glitched" pitch shifting, its signature ambience gave artists characterful doubling, delay, chorus, pitch shift, and ambient effects, from the '80s, to this day.

Add Sonic Intrigue to any Source

Use the AMS DMX Digital Delay & Pitch Shifter plug-in to add vintage digital dimension to drum machines, synths, or guitars. You can also use it for automatic double tracking effects and unique arpeggio patterns on vocals, horns, and more.

Plug-In Only Features

The AMS DMX plug-in not only gives you all the revision features of the vintage rackmount units — including the rare expansion chorus controller module — you get modern upgrades like Tempo Sync, Dual VCO mode, Dry/Wet Mix, Wet Solo, and more.

The Perfect Partner for AMS RMX16 Reverb

Combine the AMS DMX Digital Delay plug-in with the AMS RMX16 Digital Reverb plug-in for the ultimate in vintage digital processing, and give your productions the pioneering sound of two legendary creative tools.

DMX 15-80 S Plug-In Features

- Record and mix with the world's only authentic AMS DMX Digital Delay plug-in, developed by original hardware designer Mark Crabtree
- Add iconic delay and pitch shifting effects to drum machines, vocals, synths, guitars, and more
- Get double tracking effects made famous by Prince, Radiohead, and Phil Collins
- Mix with Artist Presets from Chris Coady (*Yeah Yeah Yeahs*, *Beach House*), Chuck Zwicky (*Prince*, *Reggie Watts*), Ivan Barias (*Justin Timberlake*, *Jill Scott*), and more

AMS DMX 15-80 S Operational Overview

Introduction

This overview provides a high-level understanding of the AMS DMX 15-80 S. For specific details about individual controls, see ***DMX 15-80 S Controls*** later in this chapter.

> Throughout this user manual, sections highlighted in a box like this are excerpts from the original hardware manual, for informational and historical benefit.

Wide-Ranging Delay, Pitch and Modulation Effects

Having faithfully modelled both analog and digital systems of the classic vintage hardware, the AMS DMX 15-80 S plug-in features the same hardware delay times, regeneration behaviours and delay filtering, full -/+ octave pitch shifting and voltage-controlled oscillation. The DMX plug-in can produce clean to overdriven delay, doubling, harmonizing phasing, flanging, chorus, and even looping effects just like the original hardware.

> The DMX 15-80 S is a dual independent channel microprocessor controlled digital audio processor. It offers two completely independently delayed channels with precisely controlled delay times and pitch shift. The delay times are adjustable without any sacrifice in the 18KHz bandwidth, which remains constant irrespective of the amount of delay selected.

New Plug-In Only Functionality

While the original AMS DMX 15-80 S hardware had to be patched into a console to combine dry signal with the two processed channels, the DMX plug-in provides Wet/Dry Mix and Pan controls, allowing a creative variety of blended signal and width effects. A and B channels may be repositioned or continuously moved (by way of automation) anywhere in the stereo field alongside the dry signal. In addition, internal tempo sync allows for instant timing benefits and creative beat division quantization for live use via Apollo Console, or with 'in-the-box' mixing with any digital audio workstation (DAW). Lastly, all continuous control values will temporarily show in the seven-segment LCD display for improved visual feedback over the hardware. With a single click of any knob, the user can temporarily show that parameter's value without adjustment.

Artist Presets

The AMS DMX 15-80 S includes artist presets from prominent users. The artist presets are in the internal factory bank and are accessed via the DAW application's preset menu. The artist presets are also accessible within Apollo's Console application and from the UAD Toolbar (see "Using UAD Powered Plug-Ins" in the UAD System Manual).

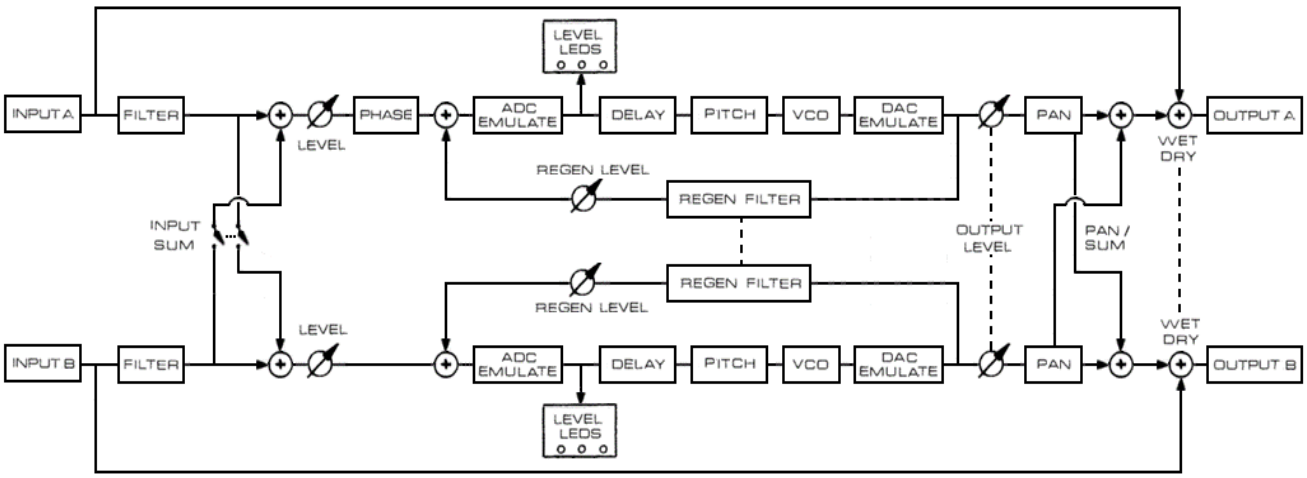
Understanding the DMX 15-80 S Feature Sections

The DMX is best understood when thought of in feature sections. While perhaps not presented in a strict linear fashion in the user interface, the sections may be interpreted in a loose left to right perspective, color-coded below for emphasis. Red: Signal routing and level adjustment controls, Yellow: Delay features and controls, Blue: VCO/modulation features and controls, Green: pitch shift and chorus controls. The remaining controls are shared among the feature sections. Observe that some controls provide individual channel adjustments (indicated by 'a' and 'b' labels) while all other controls are applied to both channels.

Looking at the front panel, it can be seen that it is divided into various sections. Probably the most effective way of learning how to operate the unit is to be become familiar with the front panel controls.

DMX Plug-In Signal Flow Diagram

This block-style signal flow diagram can help in understanding the feature section interactions and how the overall system processes incoming audio. This diagram represents both internal processing blocks and signal level user controls.



AMS DMX 15-80 S Controls

Signal Routing and Gain Control Section

This section and its features makeup all of the A and B signal routing and gain/level controls. Unity gain is achieved with Input and Output controls set to '5' (which is the default). Note the plug-in is improved over the hardware with increased gain range for both input and output controls, offering greater tonal flexibility to push the system into nonlinearity, or to better maintain unity gain. Three position LED meters are provided for monitoring the input level to each channel.

Separate input gain controls are provided for each channel. Clicking on the 'ch.a' and 'ch.b' labels returns control to unity/default, clicking the 0 labels provides immediate zero input gain values.

Output level is a ganged control that acts on both the A and B channels. Clicking on the 'output' label returns the control to unity/default, clicking the 0 label provides immediate zero output level value.

Configuration switches provide discrete channel operation or summed operation ('a|b' or 'a+b') at input and output.

The green stereo LED is lit when both switches are set for discrete operation.

In mono instances, the configuration switches are forced to 'a+b'. If only one channel is needed, the unused channel input gain may be set to zero.

Signal level is indicated with the 'h/room' (headroom) LEDs.

Pan controls are provided to place A and B channels anywhere in the stereo field. In the mono instance, or when the Output Sum is enabled, the pan controls are disabled and both channels are summed at the plug-in output. Each control's '0' label provides immediate centred pan values.

The red LEDs are illuminated 6dB before clipping, the yellow LEDs 12dB and the green LEDs 18dB.

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.

Digital Delay Section

The DMX's delay section and its features provide precise and functional delay control and flexibility for a wide swath of creative applications, from clean and crisp to extreme distortion and chaos. The delay time available for each channel is 6.515 seconds and is programmable in 1mS steps.

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 DMX 15-80 S, should not alter or modify the signal no matter what delay is programmed. The DMX 15-80 S 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.

Delay A and B

There are several ways to set delay times in the plug-in. For immediate response, adjust the Delay 'a' or Delay 'b' rotary controls in the lower control unit, either by dragging the control with the mouse, hovering over the control and using the mouse wheel, or clicking on the control and using the keyboard arrow keys (providing different rates of change by holding the 'shift' key on the computer keyboard). The delay values will be reflected in the value display, and the corresponding 'a' or 'b' LEDs will update to reflect which of the two delays is being adjusted.

The broad taper of these controls allows small values to be easily dialled in.

Clicking the 0 labels provides immediate zero delay values.

Delays can also be programmed in. First select the desired channel using the 'A' or 'B' buttons on the keypad or clicking on the 'a' or 'b' LEDs under the 7-segment display (ensuring the 'c' LED associated with setting pitch values is not also lit) and then use the keypad entry. Similarly, click on the 7-segment display for keyboard text entry to set the required delay time. Or, use the up and down nudge keys to set delay time.

Text entry may be accessed for either A or B channels by clicking in the 7-segment display,

If using the keypad entry, use the '' key for adding a decimal.*

Single-click the nudge keys for small value increments, or press+hold nudge for quick scrolling.

Regen A and B

Regen controls access independent per-channel regenerative feedback gain, which provide a full range of delay repeats — all the way to chaos-infused, near self-oscillation regeneration at the highest settings.

It is obvious that a great deal can be accomplished using the DMX 15-80 S besides simple delay. A proportion of the output of a channel may be fed back to those channels input by adjustment of the respective regenerative control knob.

Regen 'a' and 'b' gain controls allow the output of each channel to be independently mixed back into the input.

Clicking the 0 labels provides immediate zero regen values.

Filter

The Filter parameter controls the cutoff frequency of a full-range, 6dB per-octave low-pass filter applied to the individual regeneration contribution back into both A and B channels. Used nominally, this feature can provide a reduction of high frequencies for the delay repeats. At its extreme setting, the filter may eliminate delay repeats entirely. This filter is a feature found on the earliest DMX units.

The full-bandwidth, low-pass filter control allows shaping of regen signals for both A and B channels.

Clicking the 0 label provides immediate return to a zero-filter value.

Phase Channel A

Phase reverse for channel A is a feature found on the earliest DMX units and may be used for creative purposes especially when using both delay lines. The Phase switch has limited effect when pitch/chorus features are active as the pitch shifter inherently introduces varying delays which cause phase differences.

The Phase switch LED is a hidden off/on button.

Voltage Controlled Oscillator Section

With a waveform speed range from 0 to 20 Hz, the DMX's VCO section and its controls allow for a broad range of creative signal modulation for flange, phase or vibrato effects and more. 'VCO2' mode is a plug-in only enhancement that provides 90º quadrature phase offset between A and B channels, for stereo enhancement not available on the original hardware.

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The 15-80 S, 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.
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VCO Enable

This three-position switch selects among original single 'VCO' and an enhanced dual 'VCO2', providing 90º phase offset between channels. The unlabelled centre position provides bypass/off. Note that like the hardware, the VCO will only affect the sound if delay A or B is set to 2mS or more. Therefore, the VCO/VCO2 LEDs will not illuminate if both channel delays are below 2mS.

Like the hardware, the VCO will only affect the sound if delay A or B is set to 2mS or more; The VCO/VCO2 LEDs will not illuminate if both channel delays are below 2mS.

VCO and VCO2 LEDs are hidden selection buttons.

VCO Speed and Depth

VCO Speed and Depth are the primary controls on the DMX. The oscillation is sinusoidal. A dedicated LED speed indicator is provided.

VCO speed must be 0.1 Hz or higher to show an LED speed change.

Clicking the 0 labels provides an immediate zero speed or depth value.

VCO Set

The momentary VCO Set switch is a plug-in only enhancement that instantly sets the VCO oscillation to a zero-crossing position with either a positive or negative excursion, handy when used in automation to ensure the normally free-running VCO provides precisely repeatable VCO behaviours.

Pitch Shift Section

Pitch shift is the AMS DMX 15-80's centrepiece feature; its 'de-glitch' algorithm was a sea-change technological breakthrough when released. Pitch control technology has advanced steadily in the subsequent decades, but the DMX's design (perhaps 'imperfect' design by today's standards) provides an era-defining sound that has not lost its appeal and musicality and is used to this day by many audio professionals. The pitch can be adjusted between -1 octave (half the original pitch) and +1 octave (twice the original pitch), a value range of 0.5 to 2.0.

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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 deglitch option.
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Pitch Shift A and B

There are several ways to enter pitch values. For immediate response, adjust the Pitch 'a' or Pitch 'b' rotary controls in the lower control unit by dragging the control with the mouse. Hovering over the control and using the mouse wheel will result in musical semitone steps in pitch, as will clicking on the control and using the keyboard arrow keys.

The corresponding 'a' and 'b' LEDs light to indicate that pitch shifting is active.

Pitch shift controls can be reset by clicking on the corresponding LED or clicking on the 0 labels.

Pitch settings can also be programmed in. First select the desired channel using the 'A' or 'B' buttons on the keypad followed by the 'C' button or clicking on the 'a' or 'b' LEDs under the 7-segment display and then clicking on the 'c' LED (if not currently lit). Now use the keypad entry or click on the 7-segment display for text entry or the nudge keys.

Text entry may be accessed for either A or B channels by clicking in the 7-segment display.

If using keypad entry, use the '' key for adding a decimal.*

Single-click the nudge keys for small value increments, or press+hold nudge for quick scrolling.

Chorus Speed and Depth

Included in the user manual pitch control section are the Chorus features. Originally available when connected to the optional (and rather rare) auxiliary expansion controller unit, the design is based on the same pitch shifted delay line principle: The chorus effect is created by cycling through a table of different pitch values for each channel and different periods between changes for each channel.

The exact functionality has been brought to the plug-in, creating a pseudo-random effect as these sequences loop around. These continuously changing pitches mean that the delays experienced will change and sometimes there is no zero-crossing candidate for inserting in a pitch down stage, and so a crossfaded 'rough splice' will happen, just as it does with the hardware. As with the hardware master unit, the 'a' & 'b' LEDs will fluctuate to indicate the last channel that had a pitch change applied, and the updated pitch values are displayed on the 7-segment display as the sequence is executed. In addition, the plug-in chorus section provides an LED for speed indication.

Turn the Chorus Off/On with the switch. The speed LED is a hidden off/on button.

When the chorus is on, pitch controls are locked out, as the pitch is being used by the chorus feature.

Additional Information On Using Pitch

The modelled de-glitch option is included in the plug-in to provide crossfades for inserted audio; This is most important when a 'rough splice' takes place, where the inserted audio is not going to be at a zero-crossing point in the waveform. Generally, the pitch shift algorithm is best behaved at 100 Hz and above.

The unit performs at its best on programme 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, the de-glitch hardware option will significantly improve the performance under these circumstances

Remember that any Pitch 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.

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 on the 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.

Tempo Sync

With the Tempo Sync feature enabled, delay times and VCO speeds share synchronization to the DAW tempo instead of absolute time. The delay times and/or VCO speeds are expressed as fractional beat/bar rhythmic subdivision values. Move the switch to sync to enable. To adjust the rhythmic division of the delay times under tempo sync, use the Nudge buttons, or click the 7-segment display to view and select available rhythmic subdivisions from a drop menu, as shown on the right.

When Sync is active, Delay Time and VCO Speed are displayed as a fractional rhythmic subdivision of the current tempo.

The display will flash if the selected subdivision is out of range at the current tempo.

Sync and Free LEDs act as selection buttons. When Sync is activated, the nearest available subdivision is selected.

Single-click the nudge keys for beat division decrement or increment.

Note: *For complete details about this feature, see the Tempo Synchronization chapter within the UAD System Manual.*

Bit Depth

The 15 bit A/D and D/A conversion of the hardware unit is emulated in the plug-in. As a plug-in only feature, other emulated bit depths can be selected, including the option to turn off the bit depth emulation. Access to these options is with the 'D' key on the keypad.

By default, the bit depth is set to the hardware's 15 bits. Clicking the 'D' key will cycle through the options; 15bit-14bit-13bit-12bit-OFF. This provides additional creative tonal options, which can affect delay regeneration, decay noise and other behaviours. The first click of the 'D' key will interrogate the current value on the 7-segment display, after one second this display will revert.

Keypad Entry Appendix

Delay time and pitch values may be entered using the keypad.

Delay values can be entered with the keypad in milliseconds or seconds within the range of 0 and 6.515. Use the '' button as a decimal point and '#' to 'execute'.*

*Example: 1.65 Seconds would be entered as: '1*65#'.*

Pitch values can be entered with the keypad as a ratio of the original pitch within the range of 0.5 and 2.0. Use the '' button as a decimal point and '#' as 'execute'.*

*Example: 1.260 is a perfect fifth interval and would be entered as: '1*260#'.*

- Clicking either A or B buttons will cause the delay setting for that channel to be displayed in the Value Display along with illuminating the related channel Identifier LED below the display.
- Clicking the C button after either A or B results in the pitch ratio info being displayed and selected for editing in the Value Display for that channel. The related Identifier LED 'c' is illuminated below the display along with the 'a' or 'b' LED.
- Button D steps through Bit Depth values 15-12, or removes bit depth limitations with "Off" (see parameter "Bit Depth").
- Clicking in a value using 0 - 9 buttons will cause entry into the display. The new value will not affect the parameter until the data is executed using the # button or the Return/Enter key on the computer keyboard.
- Until the # button or Return/Enter key is pressed, the channel Identifier LEDs will flash indicating temporary data.
- Button * provides decimal point (.).
- Button # provides execution of keypad commands.
- Err - If more than four numeric characters are typed, or the value entered is outside the parameter's range, "Err" will be displayed to warn the user that the entry was invalid.
- Click any control in the plug-in or use the *"esc."* key on your computer keyboard to clear the "Err" display. The correct entry can then be re-entered.

7-Segment Display Appendix

The display area is used to show the value of any control that is being edited with a one second timeout. Clicking on any knob will interrogate that control value in the display area with a one second timeout. When no controls are being edited, the display will show the selection of the a, b and c Identifier LEDs.

The 'a' and 'b' LEDs indicate the currently selected channel for display, nudge key control and keypad/ text entry.

The 'c' LED indicates that Pitch is selected for control and display, rather than Delay.

Keyboard entry of Delay and Pitch values can be achieved by clicking on the 7-segment display area and entering the required value on the computer keyboard, followed by the enter key.

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DO NOT USE ARKLONE ON THE DISPLAY
FILTER as this will cause damage
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- Clicking on the display allows the user to type in a numeric value for delay or pitch parameters with their computer keyboard, via text entry:
    - "Enter" key or "Tab" applies the typed in value
    - "Esc" cancels entry, or clears "Err" status
    - The following characters are interchangeable as decimal:
      comma (,) period (.) and forward slash (/)
- Using mouse wheel while hovering the display provides 10mS value increment or decrement under A or B delay focus.
- Using mouse wheel while hovering the display provides 1/2 step interval equivalent ratio value increment or decrement under A or B pitch focus.
- If VCO Speed is adjusted from the GUI, the current Hz or beat value is temporarily displayed and Identifier LEDs are temporarily de-illuminated. After modifying the VCO Speed, the value display reverts to displaying the last delay or pitch value after a one second timeout.
- When adjusting Mix, the Mix value (0.0 to 100) is temporarily displayed and Identifier LEDs are temporarily de-illuminated.
- When adjusting any other rotary control, the control's value is temporarily displayed (0.0 to 10.0) and Identifier LEDs are temporarily de-illuminated.

Original Operational Notes from Hardware User Manual

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 see frequency table. 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 programme 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 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:

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

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 initially is 1 then change to 1.122, then 1.26 then 1.335 etc., etc.

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

Original Hardware User Manual Pitch Table

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

Original Signal Diagram from Hardware User Manual