ACM520X1

www.acmt.co.uk

Manual

Contents

Appendices

Section 1 - Introduction

1.1 - What is the ACM520X1

The ACM520X1 plug-in for Windows or Linux PCs and compatible audio workstation applications comprises a versatile stereo bus compressor based on that found in one of the best known analogue recording consoles. It can be used for obvious effects or more subtle master bus compression, as the 'glue' which holds the mix together.

1.2 - Main Features

- VST, VST3 and CLAP plug-in for 64Bit Linux PCs running a compatible host application.
- Analogue modelled zero-delay feedback design mirrors the original hardware.
- Analogue modelled harmonic drive stage adds extra 'warmth' to the sound when driven at high levels.
- Physical Control Weighting replicates the feel of high quality rotary controls, also improving accuracy for small control changes.

1.3 System Requirements

Windows:
A PC running 64Bit Windows 7 or newer and a VST, VST3 or CLAP compatible host application.

Linux:
An X11 compatible Linux distribution and a Linux VST, VST3 or CLAP compatible host application.

1.4 - About the Manual

This manual covers the installation and use of the ACM520X1 compressor. Features and operation may vary depending upon your operating system configuration and host application. Where appropriate, examples are also illustrated with screenshots of the features being discussed.

1.5 - Conventions Used

Access to menu items are shown as follows:

`Menu -> Item -> Item`

A `Mono-spaced font` Is used to illustrate commands as they are typed on the command line.

Section 2 - Installation

2.1 Download Contents

Within the folder that contained this manual you will find Windows and Linux folders containing the plug-in built for **64Bit Windows or Linux systems**. Please refer to section 1.3 for system requirements.

2.2a Installing the Plug-In for Windows

Installing the Plug-In for Windows:

Within the Windows folder you will find installers for the VST, VST3 and CLAP plug-ins. The installers will guide you through the steps required to install the plug-ins.

> *NOTE: VST3 and CLAP define specific locations for compatible plug-ins. For Windows this is normally:*
>
> **`Program Files\Common Files\VST3\[CompanyName]`**
>
> *and*
>
> **`Program Files\Common Files\CLAP\[CompanyName]`**
>
> *The installer will permit other locations however you should use only the installer recommended location for the VST3 or CLAP plug-ins. unless you are confident of a specific reason for selecting an alternative.*

The installer will only install the files necessary for the plug-in to function. It will not install anything else on your computer.

Uninstalling the plug-in:

To uninstall the plug-in It is recommended to use

`Control Panel -> Add or Remove Programs`

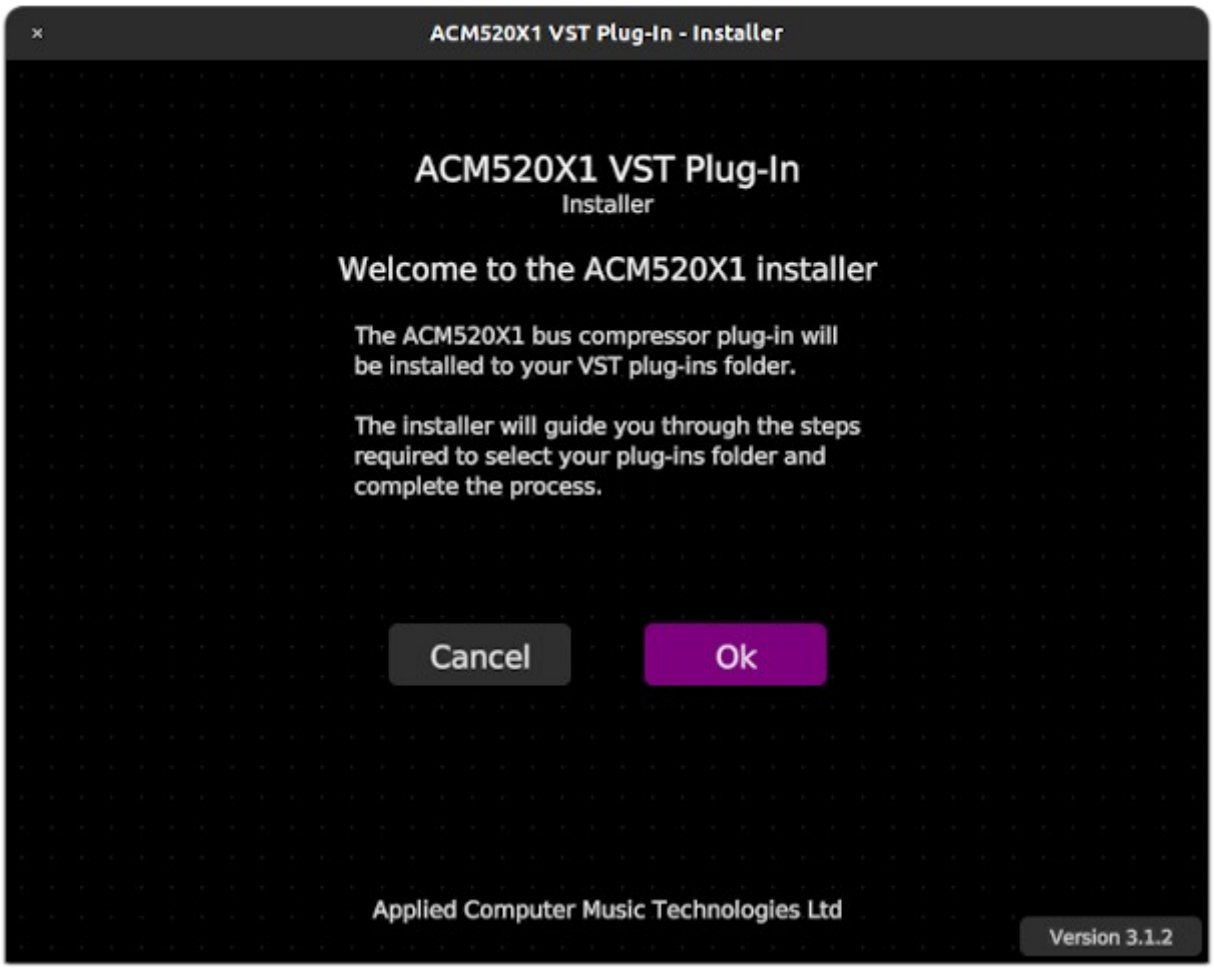
and select **Remove** for the ACM520X1.

2.2b Installing the Plug-In for Linux

Installing the Plug-In for Linux:

Within the Linux folder, you will find the x86-64 folder containing the installer executable.

Run the installer executable by (double) clicking it in a file browser, or launching it from the command line. The installer will guide you through the installation process.

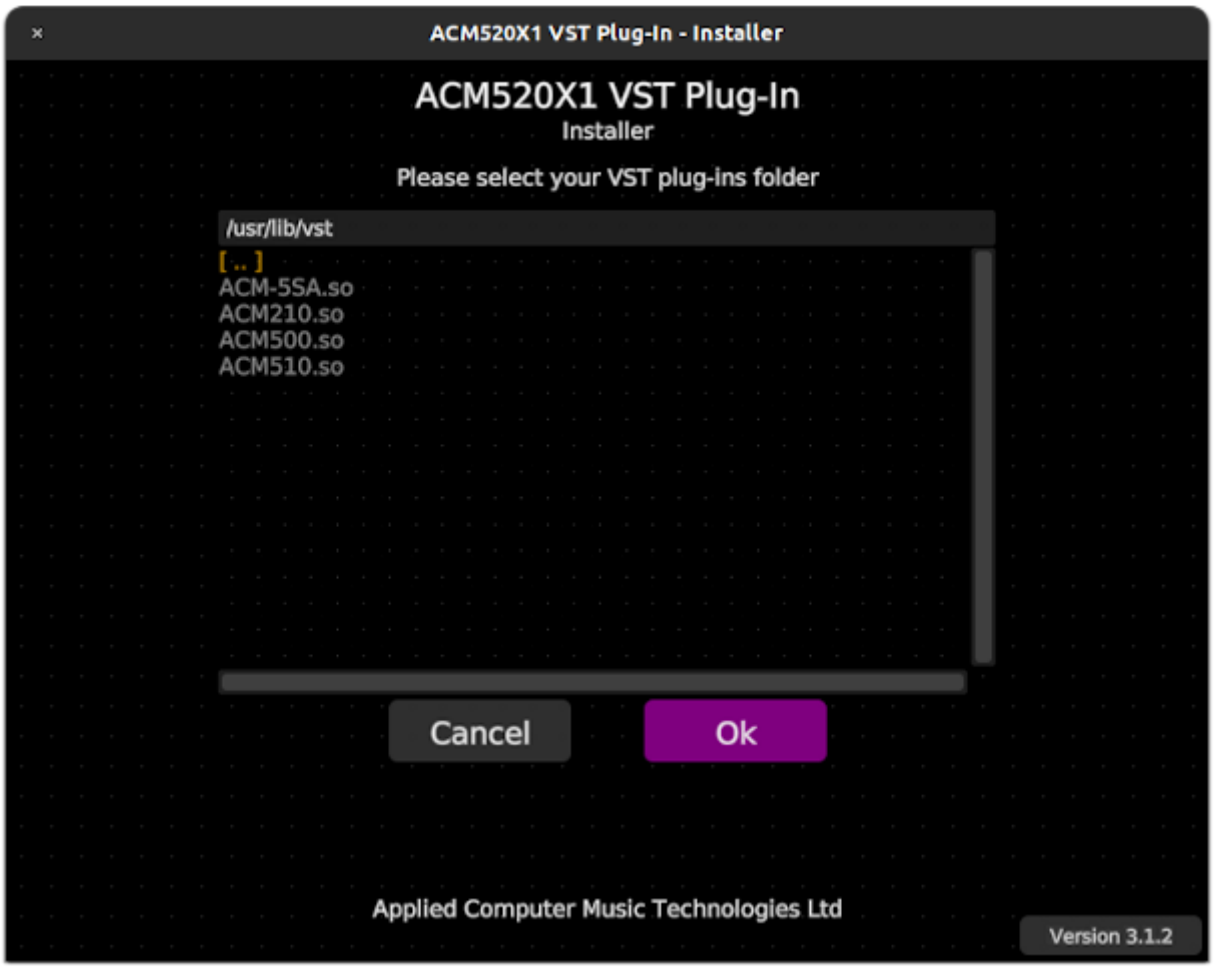


Selecting the Install Location:

The installer will prompt for your plug-ins folder location. Normally this will be `/home/your-user-name/.vst or .vst3`

It is recommended to have a single VST or VST3 plug-ins folder, but you can install the plug-ins to as many different locations as you require (just run the installer again and select a new location).

Depending upon system configuration, you may also be prompted for your user or root password if you attempt to install to a system folder, or one to which you do not have write permissions. The installer uses a standard system authentication process (`pkexec`) and does not directly gain elevated permissions.



Troubleshooting:

The installer is designed to be self-contained and compatible with most Linux distributions, if you need to backup the installer, the single executable file should be all you need. However, due to the varied and customizable nature of Linux distributions, it is possible that the installer may not be compatible with your system configuration. If this happens, follow these steps to isolate the problem or install the plug-ins manually.

1. Do not try to run the installer as the root / admin user. If you do, there will be a warning message on the console and the installer will exit. The installer is designed to be run as a normal user and will prompt for a password if required.

2. The installer uses the `pkexec` authentication method if attempting to install to a system folder, or one to which the current user does not have write access. (the installer itself never gains root or elevated permissions on your system). If this is not a standard component of your Linux distribution, you will need to correctly install and configure it for your system, or select a different install location with appropriate user access permissions.

3. In some circumstances you may need to mark the installers as 'executable' in order for them to be launched. You can normally do this by right-clicking the installer and selecting:

   `Properties -> Permissions -> Allow executing file as program`

Manually Installing the Plug-In:

If your system configuration is not compatible with the installers, you can install the plug-in manually by copying the required files onto your system. You will need to be familiar with command line operations in order to do this.

The plug-in binary files are contained in the `plug-in-binaries.tar.gz` file within the x86 or x86-64 folders. Extract the archive, and you will find it contains VST and VST3 folders.

The VST and VST3 folders contain the plug-in in Linux VST and VST3 formats.

There is also a README file which details how to copy the required files onto your system.

2.3 Product Support

If you are unsure how to install the plug-ins, or encounter problems during the installation, please contact:

support@acmt.co.uk

Section 3 - Operation

3.1 - The Graphical User Interface

This is the ACM520X1 front panel. You can control it by clicking and dragging on the rotary controls or buttons. Some controls may have detents – these manifest themselves as areas in the control rotation where the reluctance to move is increased such that you have to drag a bit 'harder'. They are intended to behave like real controls which may have a 'click stop' at OdB for example.
You can also adjust the controls by placing the mouse pointer over them and using the scroll wheel. In this case the centre indent has no effect. The way in which the rotary controls respond to mouse movement may also be affected by host application configuration, as described in the next section.

3.2 Control Modes

The control mode determines the way in which the rotary controls respond to mouse movement. This can normally be configured via the host application preferences. Please refer to your host application documentation for details.

1. Circular

This is the default mode unless changed by host application settings. Clicking on a control will move it immediately to the mouse pointer's angular position. To adjust the control, drag the mouse pointer in a circle or an arc.

2. Relative Circular (Default)

Similar to circular mode, however moving the mouse will adjust the control relative to its current setting.

3. Linear

The control responds to vertical movement. Drag up to increase the value, turning the control clockwise, or down to decrease the value, turning the control anticlockwise.

In all modes, double clicking in the centre of a control will return it to its default position.

3.3 - Physically Weighted Controls

To improve the feel of the controls, and make them behave more as hardware equivalents do, the rotary controls have been given a small amount of physical 'inertia'. This weighting does not affect the 'law' of the control, only the way it responds to mouse movement. When you begin to drag on a control, or change direction, its 'gearing' will be at a higher resolution (which also helps to locate more precise settings). As you continue to drag the control, it will become more closely geared to the mouse movement, meaning that you can still make significant control changes without large and awkward movements of the mouse.

As the controls are operated their value will be displayed in the status display in the front panel. If at any time you need to know a control's setting, just click on its centre and the value will appear in the status display.

3.4 - The Controls

The front panel controls allow you to adjust the compressor effect:

1. Gain Reduction Meter

The gain reduction meter shows the amount of gain reduction (attenuation) being applied to the signal as it passes through the compressor. The amount of attenuation is dependent on the threshold and ratio settings. Increasing amounts of gain reduction mean the compressor is having to act more strongly to control the signal level.

2. Threshold

The threshold control sets the point at which the compressor begins to act. If a signal larger than the threshold enters the compressor, it will be progressively attenuated depending on the ratio control setting. In this compressor design, the threshold will also be automatically adjusted for different ratio settings, in order to maintain perceived loudness.

3. Make-up Gain

The make-up gain control provides additional gain at the output of the compressor to compensate for the effect of lowering the threshold setting. At high ratio settings with a low threshold, the compressor output will not be much higher than the threshold level therefore additional make-up gain may be required to match the unprocessed signal. Switch the compressor in and out of circuit while adjusting the control until the processed and unprocessed signal levels are matched.

4. Attack (ms)

The attack control sets the speed with which the compressor reacts to signals which are louder than the threshold. The shorter the time, the quicker the compressor will respond to changes in input level and reduce loud signals. Set the attack to be fast (anticlockwise) if you want to aggressively control loud signals and don't want any of the initial transient to get through.

5. Release (s)

The release control sets the speed with which the compressor recovers after reducing a loud signal. Longer release times with shorter attack settings may lead to audible pumping of the output level, whereas shorter release times with longer attack may be better suited to more subtle dynamic control, for example mastering.

5a. Auto-Release

In addition to the four release time-constants, the 'auto' setting provides a program-dependent release time. This ensures the compressor reacts quickly to rapidly changing dynamics, while retaining an underlying amount of gain reduction determined by a longer average of the signal level.

Note: With very short attack and release settings, the compressor may introduce some distortion as the side chain response time becomes close to the period of low frequencies present in the audio signal. In some cases this is a desirable effect (for 'dirtying' the sound a bit), to some extent, it depends upon the effect you are trying to achieve. All compressors have their own *sound* this is due to a combination of factors including the side-chain response.

6. Ratio

The ratio control sets the amount of compression applied to audio which is louder than the threshold. In simple terms, the ratio is the ratio of the change in input level to the change in output level, so for example, if the compression ratio is set to 10:1, a change of 10dB in the input signal (assuming it is already above the threshold) will only result in a 1dB change in the output level. A ratio of 1:1 is equivalent to having no compressing action, in this case a change in input of 10dB results in a change in output of 10dB.

This compressor design is characterised by an intentional change of threshold for different ratio settings, in order to maintain a constant perceived loudness. The ratio setting also affects the compressor 'knee' – that is, how quickly the input vs output curve transitions from 1:1 below the threshold to the selected compression ratio above it. For a ratio of 2:1 the onset of gain reduction will be gradual, and the threshold will be lowest. For higher ratios such as 4:1 or 10:1, the threshold will increase and the onset of gain reduction will be more abrupt.

7. Effect In/Out

This is the bypass switch which switches the compressor and its gain controls in or out of the signal path. With the switch off (not illuminated), the signal passes through unaffected by the compressor. With the switch on (illuminated) the compressor will begin affecting the signal.

8. Side-Chain High-Pass Filter

This places an 80Hz high-pass filter into the signal path feeding the compressor side-chain. This can be useful when using the compressor on the master bus, to prevent a bass-heavy mix from triggering the compressor unnecessarily, while still controlling the upper and mid-range dynamics effectively.

3.5 - Saturation

There will always be a point at which the signal passing through the compressor cannot be turned down enough to stop it overloading or *clipping* – this is just as true of digital equipment as of analogue, at some point there will be a signal that is too large to represent either as an analogue voltage or a number in your sound-card. If this were just allowed to 'hard clip' to the maximum value permitted, the result would be a sudden harsh distortion of the signal, sometimes described as a 'splattering' sound, and not very pleasant.
One of the more pleasing aspects of classic analogue equipment is the ability to overload gradually, softening the transition from clean to distorted sound before finally clipping to a limit. That characteristic is emulated here, if you turn up the gain through the compressor it will eventually distort, but with a more gradual onset.

3.6 - Stereo Operation

The ACM520X1 plug-in is a stereo compressor. The left and right side-chains are linked, in a 'loudest wins' configuration, ensuring both channels are subjected to the same gain reduction, determined by the strongest input signal. This helps ensure stability of the stereo image.

Section 4 – System Toolbars

4.1 - Preset Selectors

In addition to the preset selector options provided by the host application, the plug-in has a pair of preset selector buttons to the right of the status display. Pressing the right or left arrows will step up or down through the factory presets and the four user preset memories.

4.2 - Info Button

Clicking on the Info button will open a pop-up showing the current version, together with a product ID code if the plug-in has been activated with a valid key.

4.3 – Demo Indicator

The red lock icon indicates the plug-in has not been activated with a valid key. To unlock the plug-in and remove the demo limitations, click the button to open the demo / activation key pop-up and enter your key (see section 4.2). Once the key is accepted, the lock will change to an open symbol. **You will need to restart the host application to complete the activation process.**

4.4 – Side-Chain HPF

The high-pass filter switch places an 80Hz high-pass filter into the audio path feeding the side-chain, reducing the effect of low frequency content on the compressor gain reduction.

4.5 – Phase / Polarity

The phase / polarity switch causes the signal at the output to be inverted. When switching between inverted and normal settings, or when bypassing the plug-in with the phase invert enabled, there may be a slight interruption to the audio.

4.6 – Output Trim

The level trim adjusts the output by up to +/- 6dB. Click on the control and drag upwards to increase the level or down to decrease. The mouse scroll-wheel can also be used to adjust the level in +/- 3dB steps. Double clicking on the control will return it to its default 0.0dB setting.

Section 5 - Presets

5.1 - Factory Presets

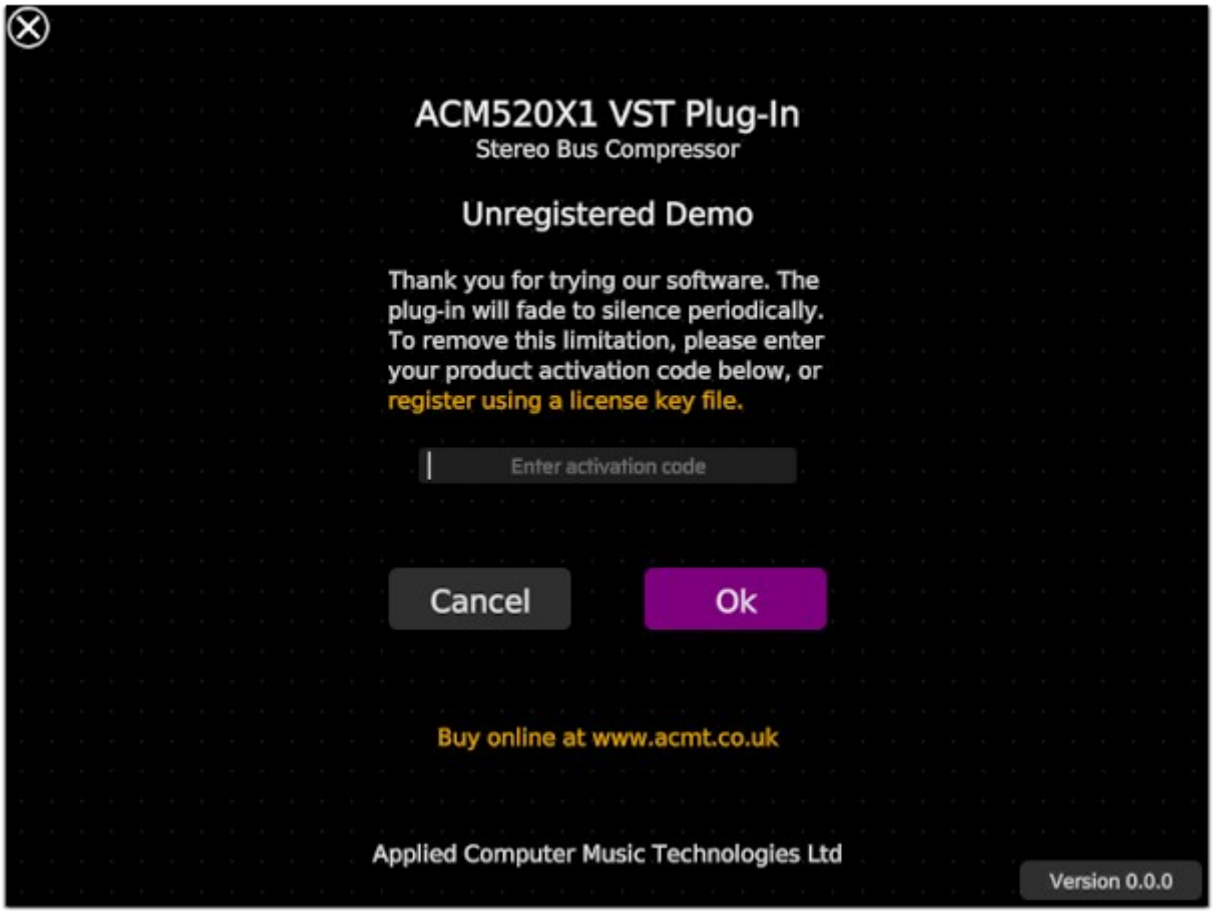
The ACM520X1 has four factory presets designed to provide a guide to some of the more common combinations of control settings.

Factory Preset 1 – Mastering 1	4:1 Compression with a moderate attack and auto-release, suitable for master bus compression.
Factory Preset 2 – Mastering 2	More gentle 2:1 compression combined with a longer attack time and fast release, suitable for more subtle master bus compression while preserving the bass transients and detail. Adjust the threshold control for 2-3dB of gain reduction and engage the side-chain high-pass filter if necessary.
Factory Preset 3 - Pumping	Heavy compression with a fast release time designed to invoke a deliberate 'pumping effect.
Factory Preset 4 - Punch	Similar to the mastering preset, but with lower threshold settings to invoke more obvious gain reduction and add a deliberate 'punch' to the sound.

Section 6 – Demo Limitations

6.1 - Demo Screen

When the plug-in is first added to a channel / bus, the following screen will appear if it has not been activated by a valid key. This indicates the plug-in is in demo mode and will run with some limitations. To remove these limitations you will need to obtain a valid activation key from the Applied Computer Music Technologies website at: https://www.acmt.co.uk



To activate the plug-in, enter your activation code into the text box (you can also paste it from the clipboard by right-clicking and selecting the 'Paste' context pop-up). You will need to restart your host application to complete the process. If you do not have a valid key, you can cancel the pop-up and activate it at another time by clicking the lock button in the plug-in's graphical user-interface.

Section 7 – How It Works

The ACM520X1 is based on the bus compressor found in one of the best known analogue recording consoles. It provides a versatile range of settings from obvious heavy compression and punch, to more subtle master bus compression, often referred to as the ability to 'glue' a mix together. In order to fully appreciate how to get the best results from the ACM520X1, it is helpful to understand some of the internal design and functionality.

7.1 - Compressor Topology

Compressors normally fall into two categories, feed-forward, and feed-back. In a feed-forward design, the *input* signal level is measured by the compressor side-chain, and fed *forward* to adjust the compressor output, according to the ratio and threshold settings.

In a feed-back design the compressor *output* is measured by the side-chain and fed *back* to control the gain reduction and compensate for any increase in the compressor output level.

The ACM520X1 is characterised by elements of both feed-back and feed-forward processing. The compressor comprises a feed-back arrangement which provides no audio output, serving only to monitor the signal level and compute the required gain reduction.

This gain reduction signal is then used to control the gain stage / main VCA of a typical feed-forward design which is responsible for attenuating the incoming audio, and adding extra 'make-up gain' if required, to create the compressor output.

In the ACM520X1 the algorithmic implementation also provides a convenient mechanism to compensate for the inherent single sample delay normally present in a digital realisation of a feedback compressor,* resulting in effectively a 'zero-delay' feedback design which mirrors the hardware implementation without additional latency.

*In an analogue feed-back compressor arrangement, the output can be fed directly to the side-chain, whereas in a digital realisation, a discrepancy arises because it is the gain reduction computed from the *preceding output sample* which must used to control the compressor's gain.

7.2 – Feed-back Compressor and Side-Chain

Although this is a stereo design, for simplicity only a single channel will be considered here.

As mentioned previously, the compressor comprises both a feed-forward and feed-back arrangement. The feed-back arrangement contributes no audio output, but serves only to compute the required gain reduction, which is then applied to the audio path via the main audio VCAs.

Audio entering the compressor is first split into two paths, the first being the main audio path going to the main VCA and then to the output.

The second path feeds the side-chain VCA, whose output contributes no audio but is monitored by the side-chain detector and used to effect gain control as it would in a conventional feed-back design.

This gain control signal is also used to control the main VCA, in what then amounts to a feed-forward configuration.

In an analogue implementation this requires careful matching of the side-chain and main VCA characteristics in order to prevent over or under compression. In hardware this is achieved using very high quality VCA modules. In a digital representation, this matching is inherent in the fact that the 'VCA's are simply two identical instances of the same processing.

7.3 – Threshold and Ratio Controls

The side-chain VCA and side-chain controls comprise a feed-back design which is used to compute the required amount of gain reduction to be applied to the main audio path via the main VCA.

Since this is a feed-back arrangement, the *output* of the side-chain VCA is rectified in the side-chain detector, to determine its peak value, before being subjected to additional gain and offset from the threshold and ratio controls.

Somewhat counter-intuitively, in a feed-back compressor the amount of gain imparted to the side-chain influences the compressor threshold (and not so much the ratio as might be expected).

For example, if the side-chain detector has more gain, the compressor will perceive that its output is louder and begin to act to reduce the level earlier, resulting in greater sensitivity or in effect a lower level onset of gain reduction, corresponding to a lower threshold setting.

Conversely, if the side-chain detector has less gain, the compressor will not be as sensitive to its own output level and the onset of gain reduction will be later, corresponding to a higher threshold setting.

In its most basic configuration, a feed-back compressor arrangement will not normally be capable of high compression ratios. Instead there will be a gradual onset of gain reduction with the threshold being influenced by the feedback loop gain. In this design, this gradual onset of gain reduction is responsible for the 'soft knee' character at the 2:1 ratio setting.

For higher compression ratios, an offset is introduced into the feed-back loop by the ratio control. This has the effect, not only of increasing the compression ratio, but also of raising the threshold, in a way which usefully compensates to maintain the perceived loudness as the ratio is increased. In addition, the onset of gain reduction becomes more abrupt at higher ratios.

7.4 – Attack and Release Time Constants

Once the signal level has been determined by the side-chain detector, it is compared with the level determined for the other channel(s), and the loudest is used to control the side-chain and main VCA gains, via the attack and decay time-constants. In hardware, these time-constants are typically implemented using simple resistor-capacitor arrangements.

7.5 – Program Dependent Auto Release

In addition to the fixed attack and release time-constants selectable by the front panel controls, an 'auto release' setting is also provided. This is accomplished by using two time constants in series, with the first being relatively fast and the second being significantly slower. In this way, brief changes in signal level result in rapid changes in gain reduction, riding on an overall gain reduction determined by a much longer average of the signal level.

Section 8 – Using the ACM520X1

The ACM520X1 is based on the master bus compressor found in one of the best known analogue recording consoles and famed for being the 'glue' on many classic mixes. The compressor is capable of subtle sonic enhancement or more obvious compression effects.

8.1 - Master Bus Compression

In one of the most common uses, the compressor is placed on the master stereo bus, providing subtle compression to 'glue' the mix together. The following is provided as an example.

Typical settings:

1. Add the compressor to the master stereo bus. While this can be done at the end of a session, it may be helpful to add the bus compressor at the beginning of a mixing session, and 'mix into' the compressor as this will also influence other mix choices.

2. Initially, set the threshold fully clockwise, in this configuration the compressor should not be acting at all.

3. Set a relatively long attack time, typically 10 or 30ms. This allows some of the initial transients to get through the compressor before it begins to turn down the gain, preserving more of the dynamic character of the mix.

4. Set a relatively short release time, typically 0.1 seconds, or use the 'auto' release setting. This allows the compressor to recover quickly and prevents the dynamics being unduly restricted.

5. Set a low ratio, most likely 2:1 although 4:1 can be used if required. This will not only provide modest gain reduction, but also ensure that its onset is gradual.

6. Gradually reduce the threshold, until the peaks in the mix cause very slight gain reduction, typically 2 – 3dB visible on the gain reduction meter.

7. Adjust the Make-up gain while matching the effected and bypassed levels.

If necessary, the side-chain high-pass filter can be switched in to reduce the effect of bass-heavy mixes on the compressor. The high-pass filter does not affect the audio path directly, however it reduces the level of low frequencies entering the side-chain, ensuring the mix is not over-compressed by heavy bass content.

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Appendix

Appendix A - Technical Data

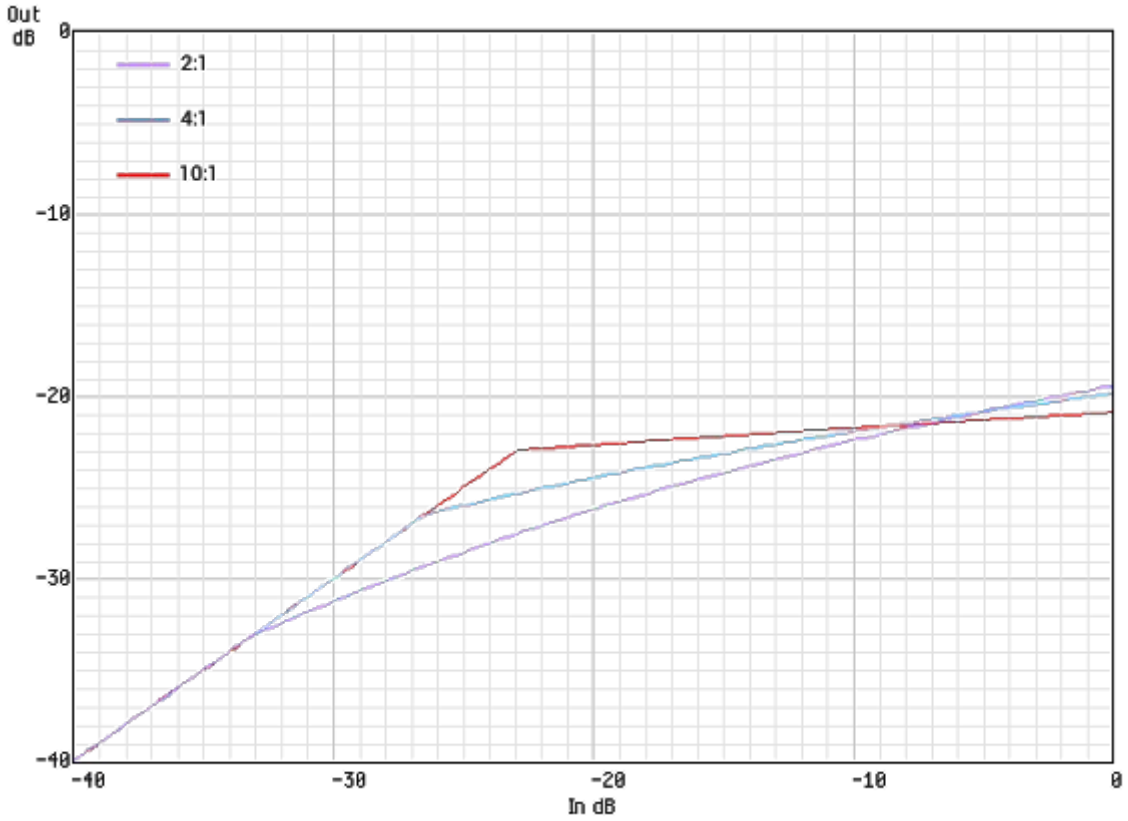
1 Technical Specifications

Frequency Response:	0Hz to Fs/2 (bypassed) - where Fs is the sample rate.
Internal Processing:	32bit floating point.
Reference Level:	0dBu = -18dBFS.
Dynamic Range:	Limited by internal processing resolution (32bit floating point) and progressive limiting after 16dBu (-2dBFS).
Compressor Threshold	-15dBu to +15dBu also dependent on ratio settings.
Attack Time:	0.1, 0.3, 1, 3, 10 and 30ms.
Release Time:	0.1, 0.3, 0.6 and 1.2 seconds and Auto-Release.
Compression Ratio:	2:1, 4:1 or 10:1
Make-Up Gain:	-5dB to +15dB.

Appendix B - Measured Performance

1 - Compression Ratio

Graph showing measured response to -40 - 0 dBFS level sweep at 1kHz with ratio settings of 2:1, 4:1 and 10:1.



Test Signal:	
Input Signal	-40 - 0dBFS level swept sine at 1kHz
Sample Rate	48kHz
Control Settings	
Threshold	0dB
Make-up Gain	0dB
Attack	0.1ms
Release	0.6s
Ratio	2:1, 4:1 and 10:1

Appendix C - Spare Parts and Service

With regular care and maintenance your new ACM520X1 bus compressor plug-in is designed to give long and reliable service. Spare parts and service updates can be downloaded from:

`https://www.acmt.co.uk`

Always ensure it has adequate ventilation and is kept free from dust. **Always use genuine replacement parts.** For service and support information contact:

`support@acmt.co.uk`

Appendix D – Disclaimer

Disclaimer

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