



LINEarise

User Manual

MAAT Inc.

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Installation & Setup

When preparing for installation of your MAAT LINearise, we recommend that you quit all applications prior to proceeding. Also, after downloading the installer and prior to installation, let any anti-malware measures you may have running scan the installer. Then, temporarily disable all anti-malware measures once scanning is complete.

To install, simply double click on the downloaded Installer for your particular operating system. The installation process will guide you through the install procedure. If you have an older OS version, restarting your host may be required. Don't forget to reenable anti-malware measures or simply restart your host.

Licensing

MAAT software is licensed through our dongle-free, cloud-based license control framework. If your hosts are net-connected, our licenses "float," making it easy to move from one machine to another. All you have to do is close all MAAT stuff on one machine before you open anything on another. If you're going to use the laptop in an environment where internet is spotty or non-existent, you can also go offline temporarily for up to 30 days.

To license your MAAT purchase, open yours or instantiate an example in your preferred plug-in host. When licensing, we recommend you open a new session in your DAW just for this purpose.



Figure 1: The initial Activation dialog

Online Activation

Once the Activation dialog appears, paste or type in your Product Key supplied at the time of purchase. Then click on Activate/Deactivate Online and follow the prompts.

 **NOTE: THE ONLINE PROCESS REQUIRES A LIVE INTERNET CONNECTION. YOU MUST HAVE AN ACTIVE INTERNET CONNECTION FOR ACTIVATION.**

A feature of our cloud-connected system is that, if you close a DAW session that contains MAAT plug instances, then open that session on another host, the license will “follow” you onto the new host as long as you have live internet.

You can also return or park your license on our licensing server, and pick it up later on another host. Once your product is licensed, click the Activate/Deactivate Online button to deactivate your license, then repeat to reactivate.

Offline Activation

If, for security reasons you have an offline host computer or you plan on working without a reliable internet connection, it is best to go with an offline license. There are two offline options, temporary offline and full offline.

Temporary Offline

If you plan on working without a reliable internet connection, we designed the temporary offline option just for you. The temporary offline process also requires a live internet connection, but only during activation.

A temp offline license has two unique features:

- It can remain offline, without an internet connection, for up to 30 days
- It auto-renews its lease whenever it does make a server connection

So, if your internet is spotty or unreliable, or you're heading temporarily to a location where an internet connection isn't available, the temporary offline option lets you work untethered to the 'net for up to a month.

By clicking the “30 Days Offline” button, your online license will become temporarily offline for a maximum of 30 days. If, however, you use the product while connected to the internet at all during that time, the “lease” duration is automatically reset, extending another 30 days.

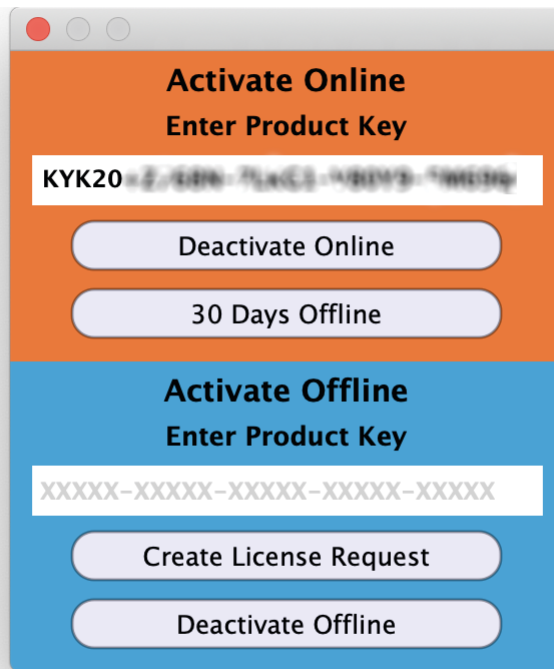


Figure 2: The 30 Days Offline activation option

Full Offline

This will license your MAAT product without the need to periodically contact our licensing server. If you anticipate working without the internet for more than a month at a time or, for security purposes, your studio machine is “air gapped” and has no internet, take a moment to surrender your online license, and replace it with an offline version.

Note: A full offline license does need to be explicitly renewed once a year.

To prepare for offline activation, you will need:

1. Your Product Key!
2. Some method to move your License Confirmation file to the offline host machine.

That latter requirement can be accomplished in any number of ways, but a USB flash drive is often readily available and most convenient. You will also need your Product Key that was supplied to you via e-mail when you purchased your MAAT product.

The offline activation process starts with generating a License Request, with a “maatr” file extension, which is submitted on-line to our server or via e-mail to MAAT Support <support@maatinc.

zohodesk.com>. A License Confirmation file, with a “maatc” extension, will be returned to you, which will activate your product.

To proceed, click on the Activate/Deactivate Offline button, and follow the prompts.

In a year’s time, 365 days from the date the maatr file is created, a full offline license must be renewed using the same maatr/maatc method.

Introduction

Thanks for installing this copy of MAAT’s LINearise re-dithering plug-in, and congratulations on committing yourself to maintaining and preserving linearity in music!

We built LIN to be used during post-production, when redithering is most needed. This is especially true during the mastering stage, where it is quite common to play back a digital stream and send that to one or more analog devices. Once the signal passes through the analog equipment, it is re-digitized and further processed in the digital domain. These steps require re-dithering and we provide quite a bit of control over that process so the engineer can customize the subjective “sound.”

LINearise’s functionality is wrapped in a visually unobtrusive user interface. The plug-in is also very “light weight,” demanding a minimum of CPU resources so it won’t slow down your host. We’ve worked hard to make this an exceptionally useful and usable tool and we hope you’ll dig it.

The Interface

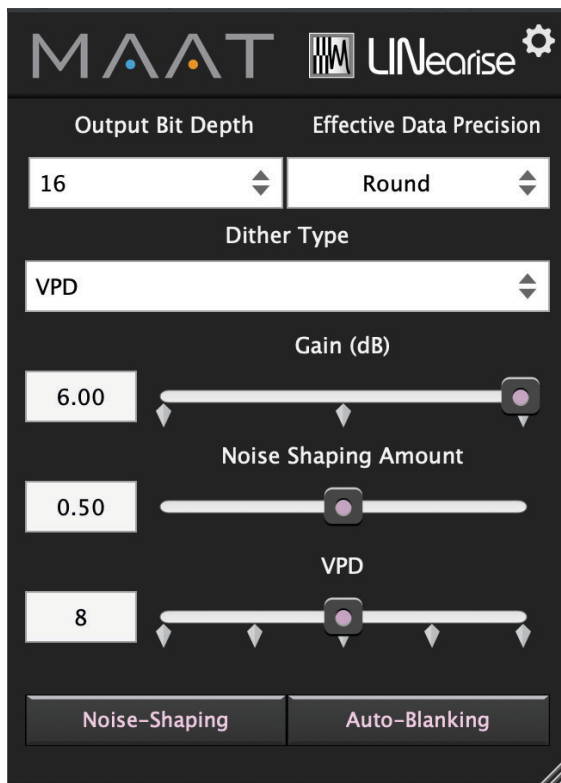


Figure 3: LINearise’s user interface

The straightforward user interface contains a series of menus and parameter controls.

Quick Start

We know, reading is old school and such an easy tool to use as LINearise would seem to be self evident, wouldn't you think? However, before you dive in with this tool, we want to make a few things clear so you will get the best use out of your "LIN" purchase. Thanks for struggling through this part!

Dither

In the digital audio world, dither is noise added to reduce distortion. What? Adding noise to decrease distortion?! Yup, let's dig in a bit...

Dither is an interesting and fundamental aspect of digital audio. Although not usually thought of as "DSP," re-dithering is definitely signal processing and so should be part of the overarching DSP umbrella. Back in the Distant Past, re-dithering was an integral part of our original digital telephone system, and much of the pioneering research on the subject was performed at Bell Labs.

According to information theory, you should add a pinch of noise to your digital audio every time you change it. Why is that? Well, take a look again at figure 3 below; that blocky looking mess that used to be a smooth and continuous low amplitude sine wave.

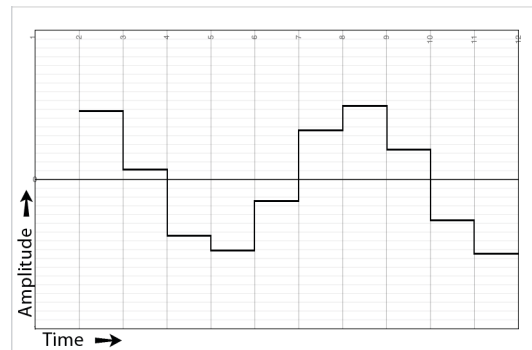


Figure 4: A digitized sine wave

Because a digitizer can only choose one discrete sample value during each sample time period, not half of one and half of another, adding a touch of noise helps to nudge the system to land on the statistically "right" choice. Injecting a hint of noise "linearizes" a digital conversion, reducing distortion. A properly designed digital system needs to add noise, called re-dithering, every time you change the gain (multiplication), or mix signals together (addition). That includes EQ, effects and pretty much anything else we typically do to our client's music!

The ideal amount of dither noise is half of the step size of the digitizer which, in the case of good ol' linear PCM on which most all of our music is based, is 0.5 times 6 dB or 3 dB. Half a bit is a very small amount of additional noise.

Without proper re-dithering, the distortion that results from any add or multiply is “correlated.” This means it bears an audible relationship or connection to the signal, the music. Trouble is, it’s distortion, so it’s a nasty sounding parody of the music and is usually considered to be quite unpleasant to listen to. When properly re-dithered, the signal is linearized, resulting in the ability to hear clean music within the noise floor at less than one bit of amplitude. In other words, that LSB, or Least Significant Bit, now can contain meaningful music “under” the noise.

There are several common types of dither, with the simplest being broadband noise, known as rectangular probability density function (PDF) dither. Mathematically, this RPDF dither has uniform or equal probability of including any frequency within the audio band from 20 to 20 kHz. So, it has equal power at all frequencies and sounds “white.” Because of its power distribution, it is quite audible, even at low amplitude and so should be used with caution. More common is triangular PDF or TPDF, which has less low frequencies and more high frequency energy. When plotted on a graph, TPDF looks tilted toward higher frequencies. Because our hearing is less acute at higher frequencies, TPDF dither is generally less audible than RPDF dither.

A fairly modern invention is “shaped” dither. Shaping refers to the power spectrum of the dither signal, which is tailored or shaped with EQ for even less audibility. Our hearing mechanism is optimized for the frequencies around which the human voice is centered so, higher frequency sounds are less audible than lower frequencies. The more you shape the dither noise, shoving the dither energy toward higher and higher frequencies, the less audible it becomes...sort of. When used in larger than normal quantities, as with several generations of processing, or when set to extreme shaping, the dither signal itself becomes obnoxious, and is a bit like the sound of nails on a blackboard.

Some examples of shaped dither brands are Apogee’s UV22HR, iZotope’s MBIT+, the Power Consortium’s POW-r, and Sony’s SBM II, (Super Bit Mapping Two). MBIT+ and POW-r are adjustable, which is not necessarily a good thing. They also require a license, increasing cost.

Limitations

When processing is performed in a DAW, dithering should be applied at the end of the deliver chain. In actuality, this is re-dithering since the ADC or analog-to-digital converter self-dithers the signal during initial digitization.

Notice I said “at the end...” This is important in that dither should only be re-applied when the content is moved out of your DAW, either by an AES/EBU or other streaming spigot, or as a file or set of stems.

In the 1990s, manufacturers began developing re-dithering schemes that provided the linearization without the audible addition of noise. The first of the resulting products was Apogee’s original UV-22, an effective if brute force approach. A handful of better performing and better

sounding spectrally shaped re-dithering products followed from several manufacturers.

Unlike the early days of digital audio, many, if not most consumers now listen to music through a largely digital signal chain. The DAC may be in their phone, embedded in their headphone cable or inside the “smart speaker” on the kitchen table. As legendary mastering engineer Bob Olhsson mentioned when asked about his re-dithering choices, “In most cases, people are never going to hear (my product) without some kind of downstream digital processing.” These days, only audiophiles have integrated amps or stand-alone preamps with analog gain staging. Re-dithering with anything other than TPDF does not “translate” well in our modern, all-digital world, as shaped dither increases distortion rather than reducing it.

With that fact in mind, one can also think of dither as just another “color” paintbrush in the DSP toolbox. No re-dithering at all produces a crunchy aspect that one well known mastering engineer employs as part of his signature sound, while more than a half step adds a veil of extra noise that may be perfect for your particular client.

Our point is: rely more on your ears. Take some time to listen to the different dither choices available in LINearise, and learn what they do to a piece of reference music played through reference consumer systems. It’s easy to do...grab some audio with which you’re familiar, and gain adjust it down by 8 bits or more, that’s at least 48 dB. Then, instantiate LINearise and turn your monitor gain up enough to hear what the different settings are doing.

To make your dither choices very audible, increase the amplitude. This is easily done by reducing the Output Bit Depth setting. Since 8 bit digital audio holds only 48 dB of dynamic range, LIN’s output at that setting is around 48 dB below full scale or 0 dBFS.

Once you’re familiar with the setup and the character of the dither generator, try a much larger gain reduction so you are “down in the mud,” where dither really counts. Be careful as this requires a huge amount of monitor gain. Then, compare TPDF to rectangular and noise-shaped in an all-digital playback scenario compared to that much rarer all-analog playback situation. Remember to gain-reduce the digital playback chain so the playback engine re-dithers the signal one more time. Then, level match the analog chain and start comparing.

In Use

Settings

The collection of controls include bit depth, dither type, dither amplitude, noise shaping amount, VPD, and auto-blanking.

Output Bit Depth

This menu sets the output bit depth for your target word length. Normally, this setting would remain at 24 (bits), though there are special situations

where you might want to change that. One example is when delivering for CD replication. In this case, you would want to set this control to 16 bits as that's all a CD can store. Same goes for special projects where fidelity is less important than payload size, when an 8 bit deliverable is requested by the client.

Effective Data Precision

In the words of our Head of Development, this setting, “reaches into the bits of every float and deciding what to do with them.” Effective precision determines what the *really* least significant bits contain. If the Output Bit Depth is set to any value other than 24, then this menu decides the contents of the defined LSB and all bit cells past that.

The three menu choices are:

- Round
- Truncate
- No Change

Round

The Round setting rounds to the desired word length. At this setting, the specified LSB represents a single bit rounding of all the lesser bits past it, those carrying information about the signal that are lower in amplitude. If Output Bit Depth is set to 16, then the 16th bit will contain a value that results from rounding the 17th through 24th bit. The 17th through 24th bit will then be “padded” with zeros or “null data.” Round is the default as rounding the excess bits produces the most linear result.

Truncate

The Truncate setting simply “chops off” or truncates all bits past the specified LSB. If Output Bit Depth is set to 16, then the data contained in 17th through 24th bit is discarded, and those bits are then filled with null data.

For a “crunchy” sound, use the Truncate setting in conjunction with Output Bit Depth set to 16, plus TPDF type dither and zero dither gain. The zero gain setting means no dither noise will be applied and, because of truncation, LIN will simply toss out the 17th through 24th bit. This means the 16th bit will not contain any low amplitude information, as it would if dither had been injected. With dither, information in the 17th through 24th bit would have been preserved. The crunchiness is caused by the low amplitude harmonic distortion generated when truncation is employed.

No Change

The No Change setting leaves all bits as they are, regardless of the Output Bit Depth setting. This setting is useful if you expect to reduce the word length later in the production process, downstream from this step.

Dither Type

LINearise offers three broad dither types: Triangular Probability Density or TPDF, Triangular Hi-Pass or weighted TPDF and VPD. A fourth setting, None, disables the dither generator while leaving the Output Bit Depth and Effective Data Precision controls active.

As mentioned earlier, TPDF is the default. Weighted TPDF shifts much of the audible energy toward higher frequencies, making it far less audible. VPD is an exclusive, variable spectrum dither feature of LINearise.

VPD

VPD or Variable Probability Density allows you to transition the dither spectrum between equal probability density, known as rectangular or uniform distribution, and Gaussian distribution, the most common bell curve in statistics. Rectangular distribution is a probability distribution with constant probability. Gaussian distribution is also known as normal distribution because, if you average sample observations of a random variable, those sampled values converge on “the normal.” With Gaussian, most of the probability bunches up in the middle, producing that familiar bell-shaped curve first discovered by Carl Friedrich Gauss.

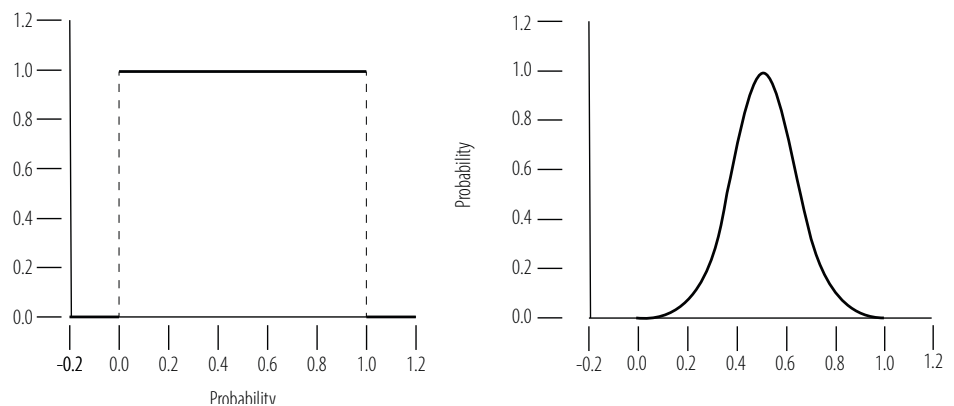


Figure 5: Rectangular versus Gaussian probability

Implementation

The Central Limit Theorem states that all averaged random numbers always tend towards Gaussian distribution. In LINearise, we can gradually change between rectangular or uniform distribution by leveraging this theorem via simple averaging. At the far left setting, LINearise generates noise derived from a continuous uniform (rectangular) probability density. If you average sufficient multiple rectangular values together, you get...Gaussian!

Rectangular dither produces a semi-correlated noise floor. Normally, you want your noise floor to be “uncorrelated” or completely random, with no resemblance to your signal. Rectangular dither has some correlation to the signal so it sounds like really distorted signal. Like truncation, this is another way to add crunchiness to your last couple of digits.

At the far right stop, the VPD control averages 32 rectangular distributions, creating noise derived from a continuous Gaussian distribution. The Gaussian setting produces noise that is less LF and midrange-heavy and thus, less audible.

How is it that averaging a bunch of almost identical rectangles doesn't produce just a really pretty rectangle? Our Adam Shield, head of development, explains that non-intuitive process like this, "Given random numbers between -1 and 1; the more of those you average, the more the result converges on zero, forming the 'bell.' It's still possible, but less likely, to get a bunch of results close to -1 or +1. Therefore the result of the average tends toward the middle, while outlier values become exponentially less likely."

Settings

With the control at far left, the noise contains a spectrum exhibiting uniform or rectangular probability. As the control is moved to the right, the noise is increasing Gaussian, with averages of 4, 8, 16, and finally 32.

Gain

The gain control provides from 0 to 6 dB of dither amplitude. At the 0 dB setting, dither noise is injected at the same amplitude as the current Output Bit Depth (LSB), while a setting of 6 dB yields 6 dB higher in amplitude than the LSB.

Some examples; with Output Bit Depth set to 16 and amplitude set to 0 dB, the dither generator will inject noise at -96 dBFS. With Output Bit Depth set to 16 (the LSB is the 16th bit) and amplitude set to 6 dB, the dither generator will inject noise at $-96 + 6$ dBFS or -90 dBFS.

At the 3 dB setting, the resulting dither is "ideal" in amplitude at one half step or half a bit. At 6 dB, the dither is one bit's worth of amplitude which is more than strictly required. That may be just what you want. Also, the 6 dB setting makes it easier to listen to the three dither types in isolation when choosing you default, go-to type.

Noise Shaping

The noise shaping controls consist of an amount adjustment and a button to enable or disable the option. The amount control provides continuous tilt, from flat or no tilt to full. Specifically, the control changes the angle of the frequency slope. The greater the amount, the steeper the drop off at the lower frequencies.

Shaped noise is not broadband noise that has been EQ'd. Shaped noise is derived from the method used to generate the noise, not how the noise is post-processed. Unlike TPD noise, which affords you an extra bit's worth of signal underneath the noise floor, shaped noise can add two bits of clean signal embedded in the noise floor.

In other words, TPD dithering embeds a 17th bit "worth" of music in a 16 bit word, while shaping can embed 18 bits in a 16 bit word. So, why wouldn't you always use shaped noise as your default choice? Because of

that modern situation of digital volume controls we find ourselves today (mentioned in the Limitations section above).

Auto-blank

The blanking option, enabled by default, automatically mutes the dither generator after a preset 11 milliseconds of silence. This prevents you from injecting noise into what would otherwise be “digital black” or null data.

Preferences

The gear icon in the upper right corner opens the info pane, with credits and a button to open this, the user manual.

Specifications

System Requirements

- macOS: 10.9 and newer, 64 bit only
- Windows: 7 and newer, 32 & 64 bit
- 4GB RAM minimum

Supported formats

- 44.1 to 384 kHz sample rate
- AAX, AU, VST 2, VST 3

Updates

Please always use the latest version of the software! You can find your current version on the Info Tab of the back panel. You can download the latest version simply by visiting:

<http://maat.digital/support/#installers>

For optimal security and stability, you should always stay up to date with Operating System revisions, and we keep up with compatibility changes to our products. We also continue to optimize for reduced CPU load, and this very user manual gets its own improvements.

To stay up to date with the latest version and product releases, please subscribe to our occasional newsletter. You'll find a opt-in form on our [Contact](#) page, or sign up for a copy of our free and very handy 2BusControl plug-in which will also subscribe you. Don't worry, we know you are busy so we only send out an average of 10 or 12 mailings a year.

Support

For product support, please visit:

<https://www.maat.digital/supports>

License Central

License Central, located in MAAT's Shared directory, is a free utility

that validates, repairs and logs your MAAT licenses. It also displays what MAAT products you have installed and assists in downloading both updates and demos.

License Central lists all of our products, and shows you:

- If a product is installed and what licenses you have [CLOUD, SUBSCRIPTION, TRIAL, OFFLINE and TEMP OFFLINE]
- What versions are installed, and version installers are available for download

It also provides:

- A one-click download of an update or a demo
- A button to activate or deactivate any of your licenses
- A copyable list of all your Product Keys
- One-click generation of the MAAT diagnostic report

It also fixes license issues automagically.

In Use

When you launch License Central, it scans your host computer and then attempts to match up each product found with a Product Key on our license server. That scanning happens in real time, and the process is shown as a progress bar. When quitting, this process happens in reverse.

Once all the licenses are validated, a list on the left displays all MAAT products, including License Central. Products that are not installed are grayed out, and installed products are displayed in high contrast. To the right of each product entry is a check mark, which indicated that the product is licensed.

Selecting a product entry displays information about the installed version and if an update is available for download.

Controls

There are two persistent buttons along the top. At upper left is Check for Updates, which refreshes the list of installed products, and pings our server again for currently available versions to download. It also recreates your Product Key list.

At upper right, the Activate/Deactivate button brings up the familiar blue and orange MAAT license window, allowing you to deactivate or return your license to the Cloud, and to switch to a 30 day temporary offline license. If you have requested a 365 day full offline license, use the Create License Request function in the MAAT license window, and have received your “.maatc” confirmation file, you can also take your license offline. Finally, you can also paste in a Product Key to activate a new license.

Note: Switching to 30 day temp offline requires that your license be already activated. 365 day full offline licenses require a license confirmation file as supplied by MAAT's support department.

If any product is out of date, a third Download Update button will appear when that product is selected. This button is an express method for updating you MAAT products.

At bottom left of the License Central window is an Auto-Refresh check box, which is selected by default. Deselecting that will prevent License Central from frequently scanning your host for changes including new installs. It starts a scan every 3 seconds, waiting for completion of that scan, then begins a new 3 second countdown before starting the next scan. If you find that License Central is interrupting you workflow while scanning, then disable Auto-Refresh.

Preferences

In License Central, the Preferences' gear icon brings up the Preferences window with four tabs.

Paths

For those who set up alternate directories for the management of their plug-ins in a DAW, two alternate plug-in paths can be defined. These directories will be also included when License Central searches.

Keys

This tab lists all of your Product Keys that are known to our license server. Please take a moment to copy all of your Product Keys, paste them into a text or word processor file, and print out a hard copy. Your Product Keys are your proof of purchase and, without them, your purchase will not work and we cannot provide product support.

Troubleshooting

The Troubleshooting tab has one button, which generates a Diagnostics Report. This report, automatically written to the Desktop, gathers useful, non-personal information about your machine's state that our support team can use to diagnose any problems.

Info

As with all our products, the Info tab lists credits, copyright information, and the version number you are running.

Share The Love

Would you like to help us in our quest for better sound quality? Help support MAAT by sharing the love...Like us on Facebook!

<https://www.facebook.com/maatdigital/>

and Twitter too:

https://twitter.com/maat_digital

Please tell your friends and colleagues about us. We really appreciate it, and thank you for supporting better quality audio.

Support

For product support, please visit:

<https://www.maat.digital/support>

Would you like to help MAAT? Help support MAAT by sharing the love...Like us on Facebook:

<https://www.facebook.com/maatdigital/>

and Twitter:

https://twitter.com/maat_digital

and tell your friends about us!

Credits

Product Concept:

Friedemann Tischmeyer & OMas

Programming:

Adam, Agent of Shield

Product Design & Development:

Oliver Masciarotte

About This Manual

This manual was written in Adobe InDesign 16.0, and is set in Robert Slimbach's Minion Pro and Myriad Pro. The cover page is set in Aldo Novarese's modernist geometric Eurostyle. O.A. Masciarotte supplied the book *To Serve & Groove*, from which some material was adapted for this LINearise user manual.

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