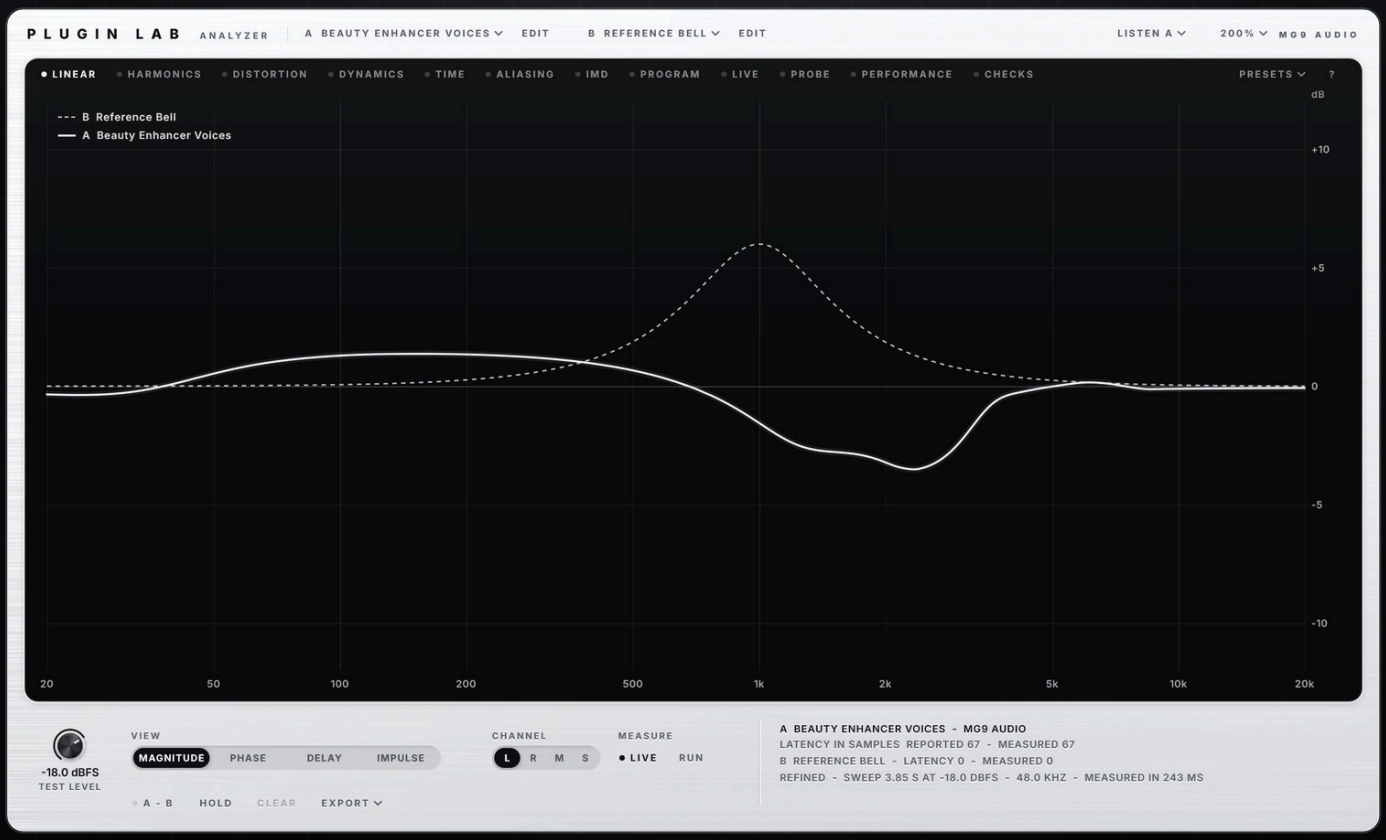
MG9 AUDIO

PLUGIN LAB

See what a plug-in really does.



USER MANUAL

VERSION 0.3.1

WINDOWS

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1 WELCOME

MG9 Plugin Lab measures audio plug-ins: frequency response, harmonics, distortion, dynamics, decay, aliasing, intermodulation, loudness, processing load. It shows on a black glass screen what a plug-in really does to the sound, and compares it with another.

HOW IT WORKS

- **It hosts the plug-in to measure.** Insert the Lab where the plug-in would go, and load the plug-in into it (slot **A**). The sound of your track goes through it as usual.
- **It measures a twin.** While its window is open, the Lab runs a second instance of each plug-in and measures that one, with the same settings, again and again. The instance your DAW plays is never touched: no test tone in your mix, no glitch.
- **The curves follow your hands.** Open the plug-in's own editor (**EDIT**) and turn its controls: the curves move with them.
- **Two at once.** Slot **B** holds a second plug-in, drawn dashed over the first: a reference, a competitor, an older version. Up to six more curves can be kept on the same chart.

WHAT IT MEASURES

TAB	WHAT YOU READ
LINEAR	Frequency response, phase, group delay, impulse response, latency reported and measured.
HARMONICS	Each harmonic (H2 to H9) and the THD against the frequency played; the Hammerstein model.
DISTORTION	The spectrum of a sine (THD, THD+N, spurious lines, noise floor); THD against level and frequency; the response at several levels.
DYNAMICS	Static curve read as threshold, ratio, knee and makeup; attack and release; waveforms and transfer.
TIME	Decay (RT60, EDT, tail); the noise when nothing comes in.
ALIASING	The spectrogram of a sweep up to Nyquist; the worst line that is not a harmonic.
IMD	SMPTE, CCIF and DFD intermodulation; a 61-tone multitone.
PROGRAM	An audio file through A and B: spectra, what changes on vowels and sibilants, spectrogram, null test.
LIVE	What really goes through A in your session: spectra, its curve measured on the music, loudness, gain, stereo image.
PROBE	Measures what the Lab cannot load: another format, your DAW's own effects, hardware.
PERFORMANCE	Processing load against block size and sample rate, and in your session.
CHECKS	Eleven checks for the classic plug-in faults.

2 INSTALLATION

WINDOWS

1. **Unzip.** If Windows blocked the download: right-click the zip > Properties > tick *Unblock* > OK, then extract it.
2. **Copy the plug-in.** Copy the whole `MG9 Plugin Lab.vst3` folder into `C:\Program Files\Common Files\VST3\`.
3. **In your DAW,** rescan the plug-ins if needed and look for **MG9 Plugin Lab** under MG9 Audio (category Analyzer). Use a 64-bit host.

THE STANDALONE APPLICATION

`MG9 Plugin Lab.exe` runs without a DAW. Keep `PluginLabScanner.exe` in the same folder: the Lab uses it to open plug-ins safely. **OPTIONS**, at the top of its window, chooses the audio interface: its input goes through A (and B) to its output, as in a DAW. The application is also how you measure **hardware** (chapter 8).

> The first time you open a downloaded program, Windows may show *Windows protected your PC*. Click *More info*, then *Run anyway*. The plug-in itself is not concerned.

MACOS

The macOS version (VST3 and Audio Unit) is coming.

UNINSTALL

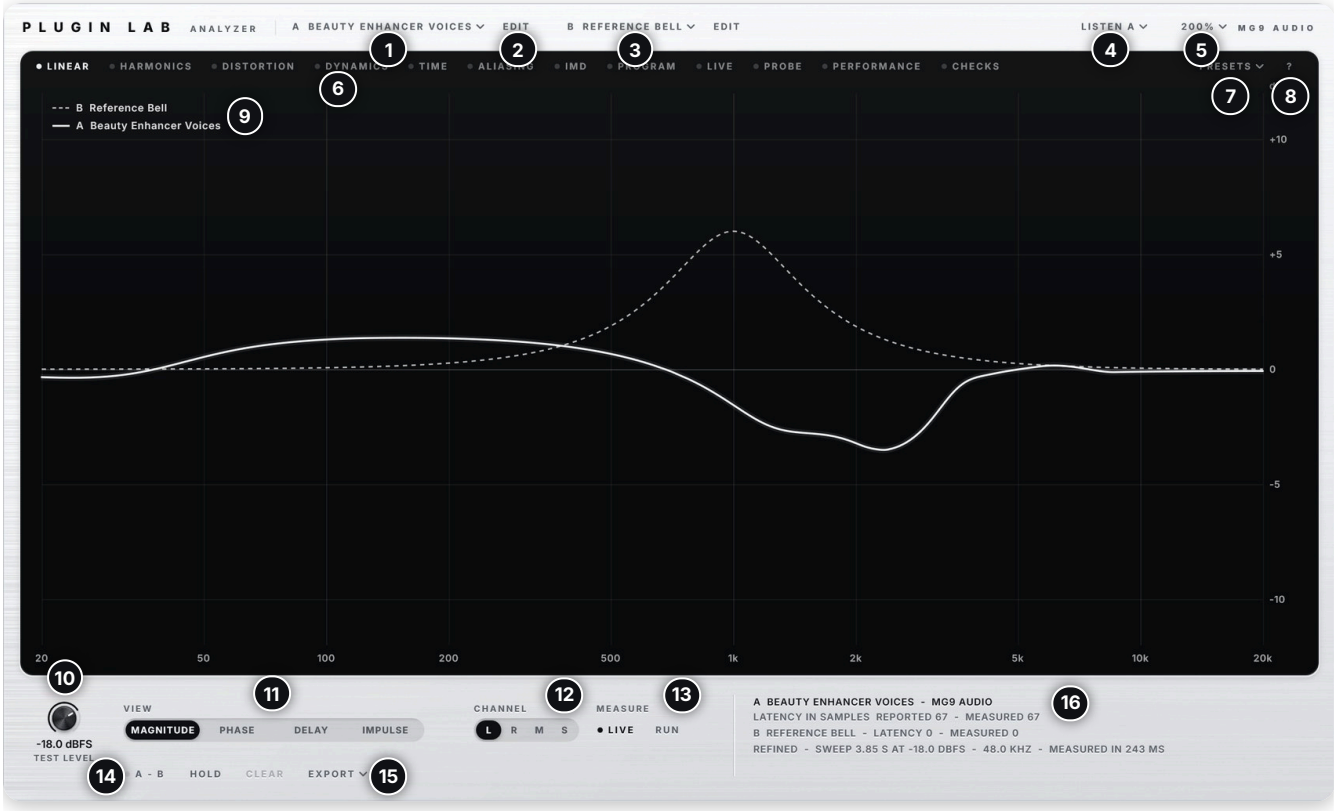
Delete the `MG9 Plugin Lab.vst3` folder and the application folder. Your favourites and the list of scanned plug-ins are in `%APPDATA%\MG9 Audio\Plugin Lab`.

3 QUICK START

1. **Insert MG9 Plugin Lab** on a track, where the plug-in to measure would go.
2. **Click A** in the header and choose the plug-in in the list. The first time, the Lab looks at every plug-in installed; this takes a moment, once.
3. **Read the curve.** It arrives by itself, a quick one first, a precise one a moment later.
4. **Click EDIT** to open the plug-in's own window, and turn its controls: the curve follows.
5. **Change tab** for another kind of measurement, or choose a **PRESET** (EQ, Saturation, Compressor, Reverb, Limiter): it opens the view that matters for that kind of plug-in.
6. **Click B** to load a second plug-in to compare, drawn dashed.
7. **Press ?** at any time: it explains the tab on screen and lists the keys.

> Nothing the Lab measures goes into your mix: the measurements run on twin instances. The sound of the track goes through A (or B, or neither) as chosen with **LISTEN**.

4 THE INTERFACE



The LINEAR tab: a plug-in in A (solid), a reference in B (dashed).

1 **A**: the plug-in to measure. Opens the list of plug-ins.

2 **EDIT**: opens the plug-in's own window.

3 **B**: a second plug-in to compare, and its EDIT.

4 **LISTEN**: what your DAW hears: A, B or the dry input, crossfaded.

5 **Size**: Small, Medium, Large, 85 to 200 %, Full screen.

6 **Tabs**: one kind of measurement each (chapter 7).

7 **PRESETS**: the right view for a kind of plug-in.

8 **?**: help for the tab on screen, and the keys.

9 **Legend**: each curve and its name. Move the mouse on the chart: the nearest curve lights up and every curve is read at that point.

10 **TEST LEVEL**: peak level of the test signal.

11 **VIEW**: the views of the tab.

12 **CHANNEL**: left, right, mid or side.

13 **LIVE** and **RUN**: measure continuously, or now.

14 **A - B**, **HOLD**, **CLEAR**: compare (chapter 6).

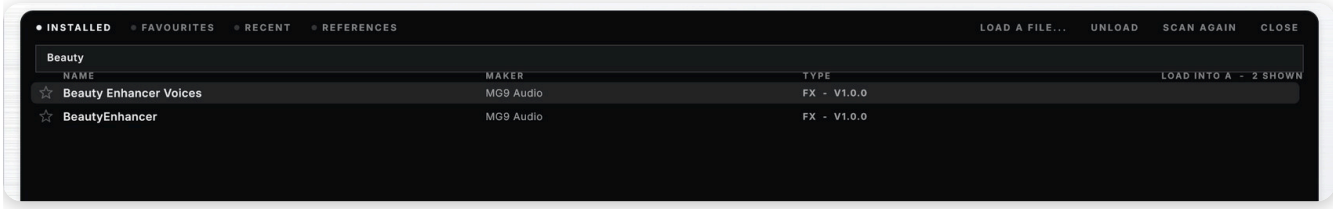
15 **EXPORT**: image, curves, full report, probe sequence.

16 **Readouts**: the numbers of the view: latency, THD, ratio, RT60, loudness...

Some tabs show other controls on the plate: **FREQUENCY** (the sine of the views that use one), **LOAD AUDIO** (PROGRAM), **RESET** (LIVE), the mode of the probe (PROBE).

5 LOADING PLUG-INS

Clicking **A** or **B** opens the list on the screen.



- **INSTALLED**: the VST3 plug-ins of your system. Each one is opened once, in a separate program, to read what it is; a plug-in that crashes or hangs there stays greyed out with the reason, and cannot crash your DAW from the list. The result is kept: the next time is instant. **SCAN AGAIN** looks again, failed plug-ins included.
- **FAVOURITES** (the star of a line), **RECENT**.
- **REFERENCES**: the Lab's own processors with a known behaviour (gain, delay, bell, low-pass, polynomial, tanh, hard clipper, filter-polynomial-filter, compressor, a decay of 1 s). Use them to learn how each view reads.
- Type to search by name or maker; arrows and Enter to load; Esc to close. **LOAD A FILE...** loads a `.vst3` from anywhere; **UNLOAD** empties the slot.

The session keeps both plug-ins with their settings. A plug-in missing on another computer is kept and saved back as it was.

6 MEASURING AND COMPARING

LIVE AND REFINED

With **LIVE** on (the default), every change of the plug-in starts a quick measurement at once, then a precise one when the controls rest; when nothing moves, nothing runs. **RUN** takes the precise measurement now. The readouts say which one is on screen (*LIVE* or *REFINED*) and how long it took.

TWO PLUG-INS

- B is drawn dashed over A. **A - B** draws the difference, B's level aligned on A (LINEAR).
- **LISTEN** (or the S key) switches what the DAW hears between A and B: compare by ear what you see.
- PROGRAM nulls A against B on real audio, and the full report compares them on every measurement.

MORE THAN TWO

1. Load the first plug-in in A and press **HOLD**: its curve stays, dimmed, named *H1* and the plug-in's name.
2. Load the next plug-in in A and press **HOLD** again: *H2*.
3. And so on: up to six kept curves, plus A and B live, eight plug-ins on one chart. **CLEAR** forgets them.

HOLD works in every tab that draws curves. B can stay a fixed reference meanwhile. Several Labs can also run side by side, one per track, each with its own A and B, to hear each plug-in in context; their curves do not mix, so compare on one chart with HOLD.

SETTINGS OF THE TEST

TEST LEVEL sets the peak level of the test signal: a saturation or a dynamic plug-in changes with it, so measure at the level the plug-in will really see. **CHANNEL** reads the left or right output, or the mid and side: the side shows what the plug-in adds between its channels.

7 THE TABS

LINEAR

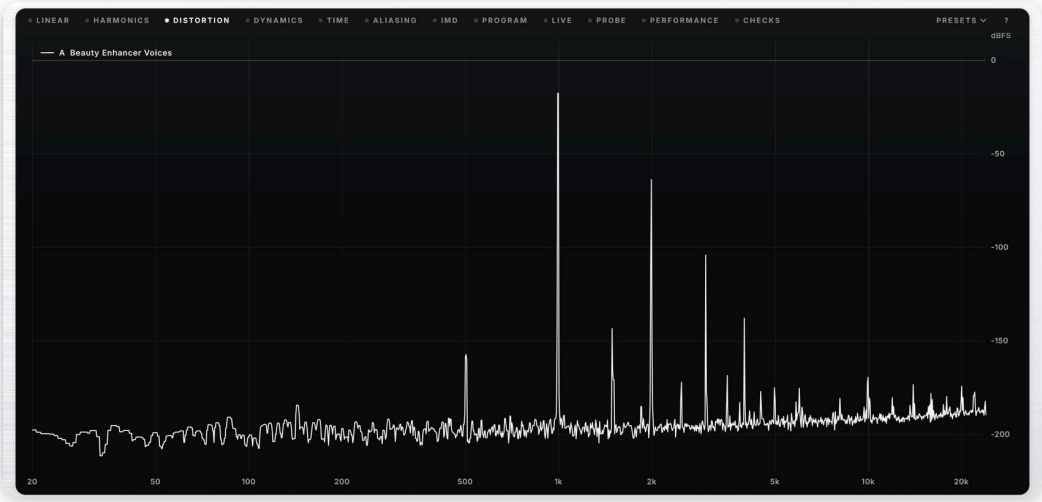
MAGNITUDE, **PHASE**, **DELAY** (group delay) and **IMPULSE**, from one swept sine. The readouts give the latency the plug-in reports and the one measured: they must agree, or your DAW will place the plug-in's sound early or late.

HARMONICS



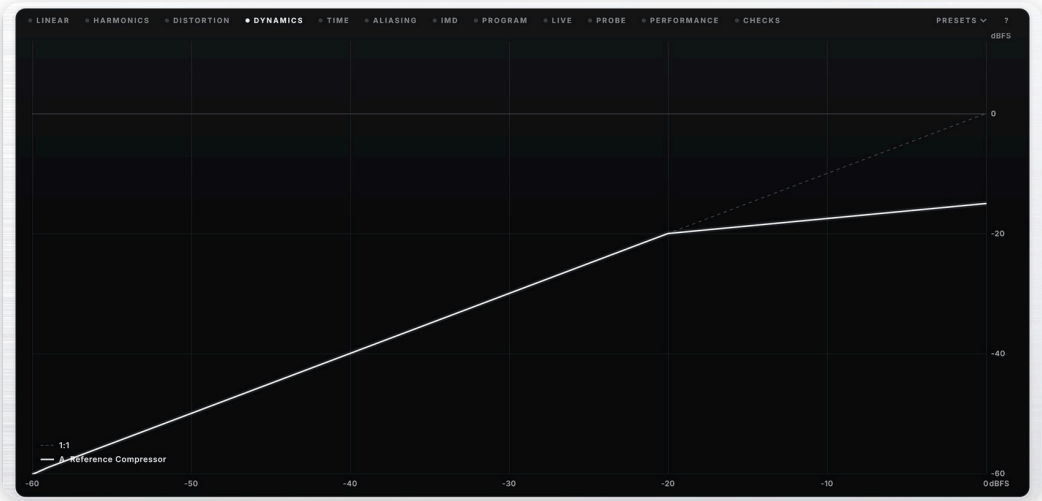
Each curve is the level of one harmonic, below the fundamental, for a sine at the frequency on the axis; THD is dashed. Even harmonics (H2, H4) tend to sound warm and thick, odd ones (H3, H5) harder. A curve stops where its harmonic would pass Nyquist. **HAMMERSTEIN** shows the plug-in as filters behind each power of the signal: where a saturation colours, and with which tone.

DISTORTION



- **SPECTRUM**: one sine at **FREQUENCY** and everything that comes out. Readouts: THD, THD+N, gain, the worst spurious line, the noise floor.
- **VS LEVEL**: THD and harmonics from -60 to 0 dBFS, sine after sine: where a saturation or a limiter starts to work.
- **VS FREQ**: the same against frequency, sine after sine; right for dynamic plug-ins, which a sweep catches moving.
- **LEVELS**: the frequency response at several levels; a curve that moves with the level belongs to a dynamic or saturating plug-in.

DYNAMICS



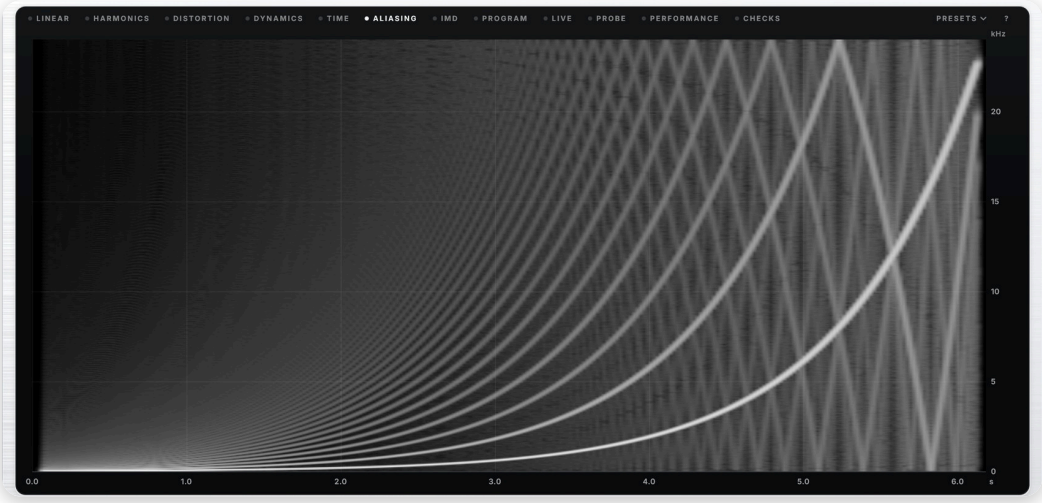
- **STATIC**: output level against input level, the 1:1 line dashed. The readouts estimate threshold, ratio, knee and makeup.
- **ATTACK**: the gain around a step from -40 to -10 dBFS and back: attack and release times at 63 and 90 %.
- **SCOPE**: the waveforms. **TRANSFER**: output against input over one period at four levels; a line is memoryless, a loop has memory or phase shift.

TIME



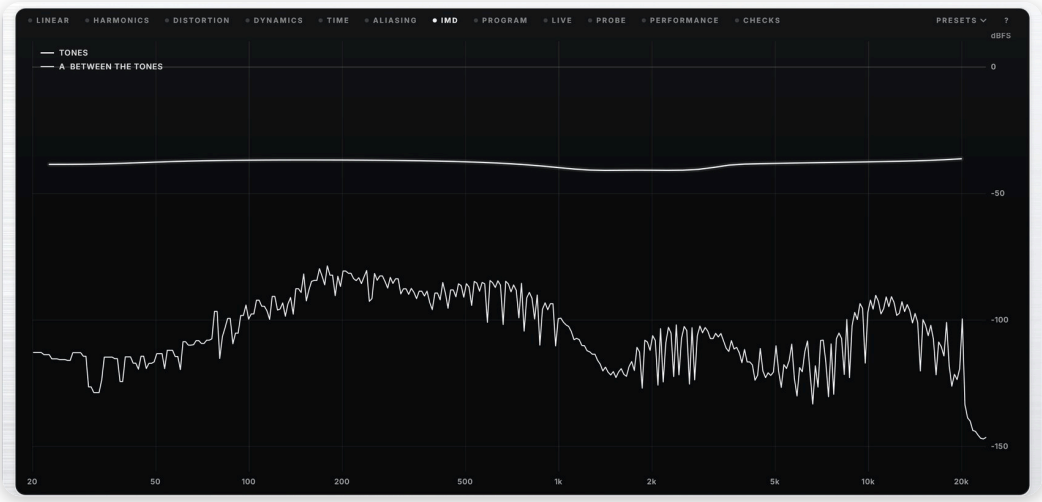
DECAY: the decay of the impulse response (Schroeder integration), with RT60, EDT and the tail down to -60 dB; the ringing of the measurement itself is taken out, so a plug-in with no tail reads no tail. **NOISE**: what comes out when nothing goes in: RMS, peak, DC and the spectrum of the noise.

ALIASING



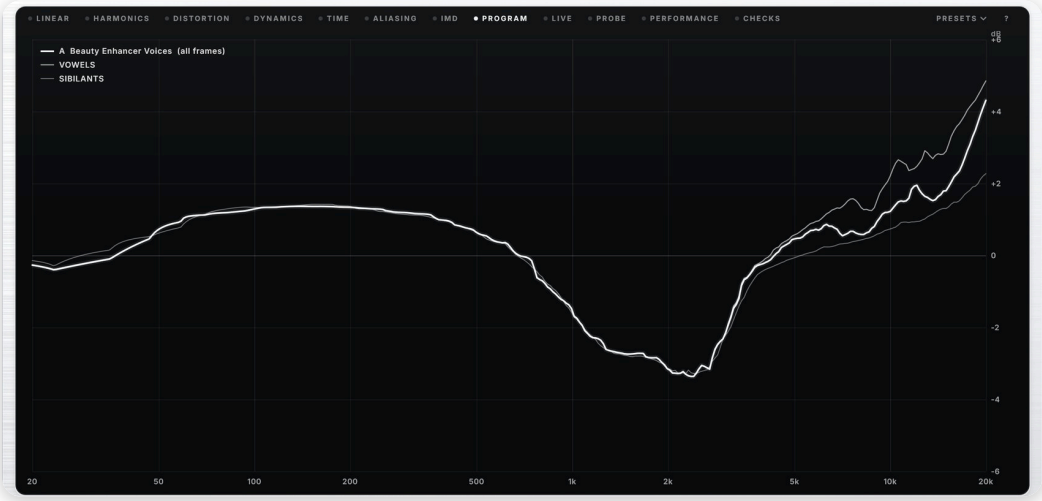
SPECTROGRAM: a sweep up to the Nyquist frequency, drawn as a picture against time. The bright line rising is the sweep, the lines above it its harmonics. **Lines falling from the top are aliasing**: harmonics that passed Nyquist and folded back, heard as inharmonic hash. The mouse reads time, frequency and level. **WORST LINES** gives the numbers: the worst line that is not a harmonic, sine after sine, for A and B.

IMD



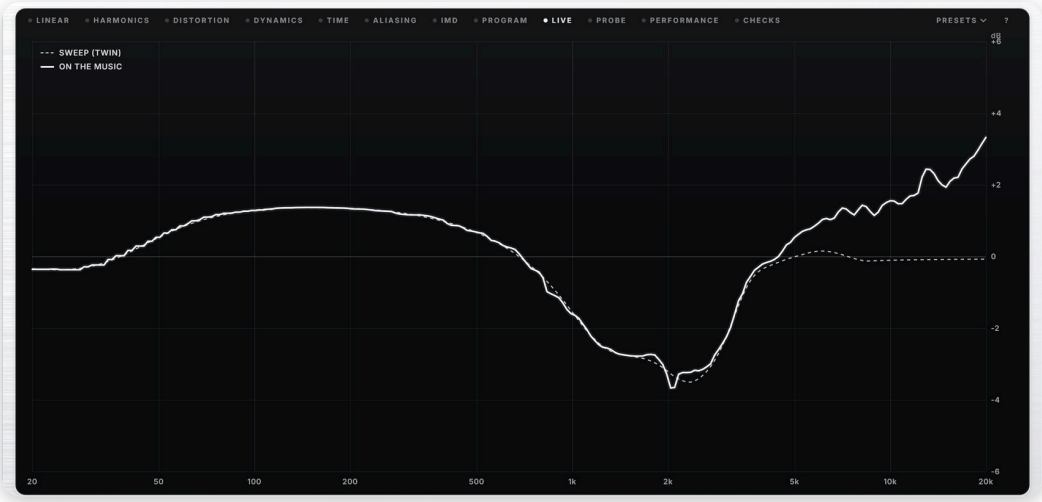
Two-tone tests: **SMPTE** (60 Hz and 7 kHz, 4:1), **CCIF** (19 and 20 kHz) and **DFD** (two equal tones 80 Hz apart around **FREQUENCY**). The readouts give the intermodulation and its 2nd and 3rd orders apart. **MULTITONE** plays 61 tones from 20 Hz to 20 kHz at once: everything between them is distortion and noise, every order together, on a signal close to music.

PROGRAM



Drop an audio file on the screen (WAV, AIFF, FLAC, Ogg, MP3), or click **LOAD AUDIO**: A and B play its first minute. **SPECTRUM**: the long-term spectra of the input, A and B. **DIFFERENCE**: what the plug-in changes, on all frames, on vowels and on sibilants apart. **SPECTROGRAM**: what A plays. **NULL**: A minus B, aligned and level-matched. The readouts give the loudness of each and the true peak.

LIVE

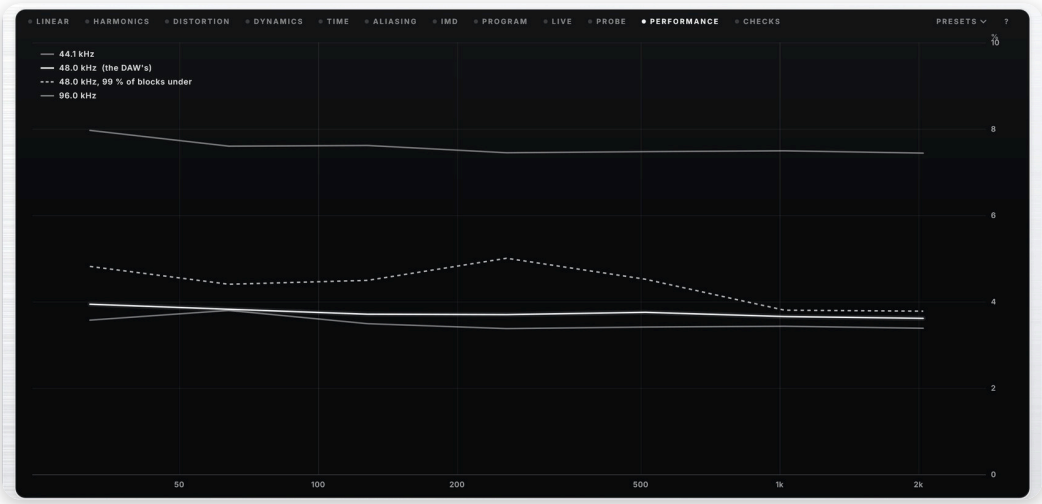


What really goes through A in your session, while this tab is shown (nothing is copied otherwise).

- **SPECTRUM**: the input and the output of A.
- **TRANSFER**: A's curve measured **on the music**, drawn only where the music is coherent enough, over the curve of the sweep (dashed). A plug-in that reacts to the signal shows here what a sweep cannot: above, an enhancer lifts the top of a voice by up to 3 dB while the sweep sees it flat.
- **LOUDNESS**: momentary, short-term and integrated loudness (ITU-R BS.1770), true peak.
- **GAIN**: output over input against time: a compressor or a limiter at work.
- **STEREO**: goniometer and correlation.

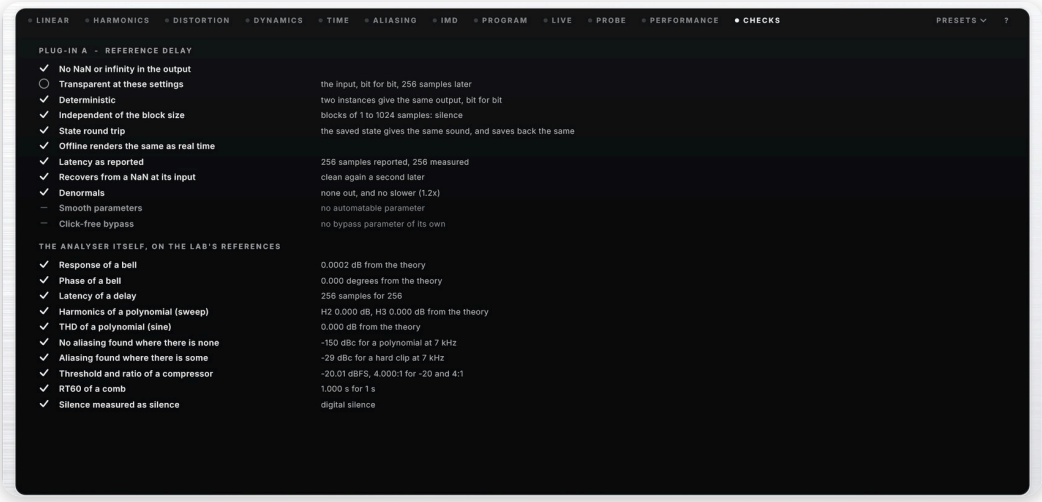
RESET starts the averages, loudness and peaks again.

PERFORMANCE



BLOCK SIZE: the processing load of A, measured on another instance, at 7 block sizes and at 44.1, 48 and 96 kHz: the mean, and the level 99 % of the blocks stay under. **IN THE DAW**: the real load of A in your session, block after block.

CHECKS



Eleven checks of A, each marked passed, failed, to know, or not relevant:

CHECK	WHAT IT FINDS
No NaN or infinity	A plug-in that outputs invalid numbers on plain noise.
Transparent	Whether it changes the sound at the current settings.
Deterministic	Two instances that sound different: randomness, time dependence, a demo noise.
Block size	A sound that changes with the DAW's buffer size (1 to 1024 samples).
State round trip	A saved session that does not sound the same when reopened.
Offline	A render that differs from playback (often on purpose: to know).
Latency as reported	A latency that differs from the one the DAW compensates.
Recovers from a NaN	A plug-in that stays broken after one invalid sample.
Denormals	Tiny numbers that slow the processor down on a fading signal.
Smooth parameters	Clicks when a control jumps (automation).
Click-free bypass	A bypass that clicks.

VERIFY THE ANALYSER measures the Lab's own references and compares them with their theory: the analyser checks itself.

8 THE PROBE

For what the Lab cannot load: a plug-in of another format, your DAW's own effects, outboard hardware.



A Lab plays a test sequence of 13.6 seconds that describes itself; whatever comes back is decoded with the same measurements as a loaded plug-in, so the numbers are the same. The latency is found to the sample, and a clock that drifts (hardware, a resampled render) is measured and corrected.

BETWEEN TWO LABS: SEND AND RETURN

1. Insert a Lab before what you measure, mode **SEND**, and another one after it, mode **RETURN**.
2. Start the DAW's transport, then click **PLAY THE SEQUENCE** on the SEND.
3. The RETURN starts listening by itself (or click **LISTEN NOW**), stays silent while it listens, then shows the curves.

The latency can be read only when the transport runs while the sequence is sent; otherwise the Lab says so.

HARDWARE: LOOP

In the standalone application, connect an output of your audio interface to the hardware, and the hardware back to an input. Mode **LOOP**, then **PLAY AND LISTEN**: the latency is the exact round trip through the interface. Start with the levels low.

ANYWHERE ELSE: FILE

EXPORT > *Save the probe sequence (WAV)*; render it through what you measure (bounce, offline render, recording); mode **FILE**, **ANALYSE A FILE…** on the result.

> *Sequence not found*: the sequence did not come back whole. Check the routing and the level, and that the render is complete.

9 EXPORT AND THE FULL REPORT

- **Save the chart as PNG**, **save the curves as CSV** or **copy them**: what is on screen, by default in `Documents\MG9 Plugin Lab`.
- **Full report (HTML)**: the Lab measures copies of A and B, with their settings, on every measurement (response, harmonics, sine, THD, aliasing, intermodulation, dynamics, scope), plus the audio file of PROGRAM and the null test when there is one. It writes a web page with all its charts, and the numbers in a JSON file, in `Documents\MG9 Plugin Lab\Reports`, then opens the page. A few seconds to a minute, depending on the plug-ins.
- **Save the probe sequence (WAV)**: chapter 8.

10 PRESETS, KEYS AND SIZES

PRESETS

PRESET	OPENS
EQ	LINEAR, MAGNITUDE, at -18 dBFS
Saturation	HARMONICS, at -12 dBFS
Compressor	DYNAMICS, STATIC (threshold, ratio, knee), at 997 Hz
Reverb	TIME, DECAY (RT60, EDT, tail), at -12 dBFS
Limiter	DISTORTION, VS LEVEL (THD against level up to 0 dBFS), at 997 Hz

KEYS

They work once you have clicked on the Lab. Ctrl, Alt and the space bar stay with your DAW.

KEY	ACTION	KEY	ACTION
← →	previous or next tab	S	listen to A or B
↑ ↓	previous or next view	P	presets
R	run: measure now	E	export
L	live on or off	F F11	full screen
H C	hold a curve, clear them	? F1	help
D	A - B	Esc	close the help, the list, full screen

HELP



SIZES

The size key (*100%*): Small (1100 × 660), Medium (1240 × 744), Large (1440 × 864), and 85 to 200 %; you can also drag the corner of the window. **Full screen** (or F) fills the screen; Esc brings the Lab back.

11 HOW IT MEASURES

- **Swept sine.** A synchronized exponential sweep, deconvolved so that each harmonic order comes apart in time with its phase (Novak, Lotton and Simon, JAES 2015). Each order is read behind the measured latency, so a short sweep also measures plug-ins with a long latency; the pre-ringing of linear-phase plug-ins is kept.
- **Sines.** Double-precision FFT with a Kaiser window, side lobes near -190 dB; levels are lobe energies, right wherever the sine falls between the bins. Test frequencies avoid the divisors of the sample rate, so aliasing cannot hide on a harmonic.
- **Loudness.** ITU-R BS.1770-4 with its gates; true peak by 4x oversampling.
- **On the music.** Cross-spectra averaged over time, the input delayed by the latency; the coherence says where the music excites the plug-in enough to trust the curve.
- **The probe.** The sequence is made of the measurements' own test signals, between two sync chirps; the decoder replays what came back to the same measurements. A drifting clock is corrected by a 64-tap windowed-sinc resampler, flat to 0.01 dB up to 0.45 of the sample rate.

ACCURACY

Every version is checked against processors whose behaviour is known exactly:

- the response of a delay to 0.0003 dB, a bell filter to 0.0000 dB and 0.000 degrees;
- the harmonics of a polynomial and of a filter-polynomial-filter system to a few thousandths of a dB of the theory;
- intermodulation of 2nd- and 3rd-order systems to 0.001 dB; a stereo 1 kHz sine at -20 dBFS reads -20.0 LUFS (EBU Tech 3341);
- the probe finds an unknown delay to the sample and the hosted response to 0.0000 dB; a clock 120 ppm away is seen and corrected;
- each of the eleven checks is proven against a faulty reference made to fail it.

12 SPECIFICATIONS, LIMITS AND SUPPORT

ITEM	VALUE
Formats	VST3 plug-in and standalone application, Windows 10 and 11, 64-bit. macOS coming.
Hosts plug-ins	VST3, two at once (A and B), plus six kept curves.
Sample rates	The DAW's; the measurements adapt to it.
Latency of the Lab	That of the hosted plug-ins (the longer of A and B), reported to the DAW.
Parameters seen by the DAW	Bypass, Listen (A, B, Dry), Output.

LIMITS

- **The twin** assumes a plug-in sounds the same in two instances. A plug-in that refuses a second instance (some licences) cannot be measured live; LIVE and PROBE still work.
- **Plug-ins that follow the level** or change over time are seen by a sweep at one moment: prefer the sine-after-sine views, PROGRAM on real audio, or LIVE.
- **A plug-in that crashes** takes the DAW with it, as in any host. The list keeps out the plug-ins that crash when opened, not those that crash later.
- The side chain of a hosted plug-in receives silence; MIDI is not sent.
- A plug-in that needs a licence must be authorized on the computer, or it may output silence or a demo noise.

SUPPORT

News, updates and support: **patreon.com/c/MG9Audio** and **mg9records.com**.

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