APU Loudness Meter

User Manual

v5.5.6

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1. Introduction

APU Loudness Meter is a modern loudness analysis plug-in released by APU Software, LLC. This plug-in is designed to provide both real-time monitoring and full histogram analysis of your audio's loudness over time. Here you can read about the different features and parameters available with the meter.

2. Parameters

This software supports a variety of parameters, most of which can be adjusted in real-time. This section provides an overview of each parameter, with each subsection detailing the parameters for the associated tab in the user interface. From within the user interface, you can also hover the mouse over a slider, combo-box, or checkbox to see a popup description of the parameter.

2.1. Meters

The meters tab contains configuration, visualization, and statistics for loudness analysis. This section details each of the individual parameters and components.

2.1.1. Presets

Loudness Meter's presets combo-box contains a collection of basic presets.

> The preset browser includes user-scope load options for ordinary preset changes. Reset on preset load runs a filtered parameter reset before the preset is applied. Load preset visuals controls whether the preset can change the hinted theme and visualization settings. Full Reset always restores all default parameter values, regardless of these options. Load preset ranges protects target range settings. When disabled, target range values are skipped during both the pre-load reset and the preset load. You can switch between loading dark or light themes through the dark mode parameter.

Currently, the following presets are available ("Full Reset" restores all default parameter values):

- Full Reset
- Live Monitoring - APU Default
- Live Monitoring - Apple
- Live Monitoring - Deezer
- Live Monitoring - Spotify/Tidal/YouTube
- Live Monitoring - Spotify Loud
- Full Histogram - APU Default
- Full Histogram - Apple
- Full Histogram - Deezer
- Full Histogram - Spotify/Tidal/YouTube
- Full Histogram - Spotify Loud
- Visualization - History (Spiral)
- Visualization - History (Swirl)
- Visualization - History (Polar)
- Visualization - History (Wave)

2.1.2. Loudness type

The loudness type combo-box and channel-link button allow you to configure the type of loudness measurement to use. Each loudness type supports channel-split or channel-linked processing. Channel-split treats each channel independently, while channel-linked integrates across all channels.

Three of the supported loudness types use a popular modern measurement standard for perceived loudness called LUFS. These loudness types are momentary (400ms window), short-term (3s window) and Integrated (infinite window).

There are also two peak loudness types (True Peak and Peak) as well as traditional RMS. True Peak is an improvement on peak which takes into consideration waveform behavior between samples, which allows it to properly respond to inter-sample peaks. Peak mode loudness types use a blocksize window.

> Integrated loudness type window can be reset by pressing the reset button.

2.1.3. RMS window

The RMS window parameter allows you to adjust the duration of the RMS window in milliseconds. Lower window durations respond more quickly to changes in loudness, while higher window durations provide a more stable loudness measurement. The RMS window is used by the RMS loudness type.

2.1.4. Momentary window

The momentary window parameter allows you to adjust the duration of the momentary window in milliseconds. Lower window durations respond more quickly to changes in loudness, while higher window durations provide a more stable loudness measurement. The momentary window is used by the Momentary loudness type.

2.1.5. Short-term window

The short-term window parameter allows you to adjust the duration of the short-term window in milliseconds. Lower window durations respond more quickly to changes in loudness, while higher window durations provide a more stable loudness measurement. The short-term window is used by the Short-term loudness type.

2.1.6. Output type

The output type combo-box allows you to configure which type of metering measurement is displayed by the visualizer. These measurements are displayed using the current output color.

Integrated output type takes into consideration the full history of audio since last reset, and is implemented according to the LUFS specification.

History average, history peak, and history min are based on the history buffer, whose length is configurable from the visualization tab. This allows you to continuously analyze any length of time supported by the history length parameter.

Global average, global peak, and global min analyze all loudness measurements since the last reset.

PSR (peak-to-short-term loudness ratio) compares true peak against short-term LUFS, which makes it useful for spotting heavily limited passages and mix density changes.

PLR (peak-to-loudness ratio) compares true peak against Integrated LUFS for a program-level dynamic range summary.

Crest compares sample peak against RMS, which gives a traditional peak-to-average dynamic range view.

2.1.7. Visualization

The visualization component displays a continuously evolving real-time view of your source and output loudness over time. There are currently two main types of visualizations: history and histogram. History displays a rolling window of the most recent history of loudness samples. Histogram divides this history up into buckets and displays the relative proportion of each bucket in real-time.

> You can hover the mouse over a bucket to see the loudness range the bucket corresponds to.

The visualization component also displays the current target range, allowing you to precisely target this range based on the dynamics of the audio. Detailed visualization settings can be adjusted from the visualization tab, with some features also available by right clicking on the visualization component.

> You can double-click the visualization component to zoom in and hide everything else.

2.1.8. Raster type

The raster type parameter allows you to specify the type of raster visualization. You can select between history and histogram views, with either loudness or delta values. Loudness values match the currently selected loudness type while delta values take the difference between target and output (meter) loudness.

2.1.9. Raster orientation

The raster orientation parameter allows you to specify the rotation of the raster visualization. You can select between horizontal and vertical orientations.

2.1.10. Live monitoring

The live monitoring option enables continuous loudness measurements and visualization. When disabled, only arrangement/timeline playback will be monitored. This can help ensure the accuracy of loudness measurements and statistics.

2.1.11. Reset meters

The reset button resets history and histogram visualizations, along with any accumulated statistics data.

2.1.12. Open file

The “Open file ...” button allows you to perform analysis on any supported audio file. This will also clear all previous history and histogram visualizations, along with any accumulated statistics data.

This feature automatically switches to histogram view after analyzing the file, which allows you to quickly view the dynamic range of the audio material. Statistics will reflect the contents of the audio as well.

> After opening an audio file, press the “Close file” button to return to live monitoring.

2.1.13. Analyze all

The analyze all parameter allows you to specify whether analysis should include all loudness types or only the currently selected loudness type. This allows you to save time when processing long audio files by only analyzing the loudness type you’re interested in.

2.1.14. Target range

The target range parameter allows you to specify a min and max loudness value for the target range, displayed in the visualization component as an overlay.

> This option will only be visible if the show thresholds parameter is enabled.

> See range sliders for information about range sliders in general.

2.1.15. Learn target range

The learn target range parameter allows you to enable or disable learning for target range.

While active, target range will be adjusted to follow the input loudness distribution rather than raw peaks. The learn algorithm uses LRA-style percentiles (10th/95th) from the input histogram and smooths updates using the current attack/release ballistics. This is useful for quickly setting the target range to a representative window of the input, then disabling learning to prevent the target range from changing.

2.1.16. Target range presets

Target range presets are provided for convenience as an example set of industry related loudness ranges. The average loudness and limiter peak are provided in the preset names in parenthesis. These values were transcribed from the RTW delivery standards page.

Currently, the following target range presets are available:

- APU Default (-20/10)
- Standard Reference (>= -60)
- Spotify Loud (-11, -2)
- Spotify/Tidal/YouTube (-14, -1)
- Deezer (-15, -1)
- Apple / Podcast (-16, -1)
- Podcast (Mono) (-19, -1)
- EBU R128, Broadcast (-23, -1)
- ATSC A/85, US TV (-24, -2)
- Netflix (-27, -2)

2.2. Loudness

The loudness tab contains parameters relating to loudness measurements and detector behavior.

2.2.1. Adaptive startup

The adaptive startup parameter enables or disables adaptive startup behavior for loudness measurements. When enabled, the loudness window begins small and grows as the window fills. This can be useful for reducing transient artifacts at the start of playback.

2.2.2. Adaptive edges

The adaptive edges parameter enables or disables adaptive edge detection for loudness measurements. When enabled, loudness values crossing the configured adaptive threshold, or silence, will be detected and the loudness window will be reset. This causes the adaptive startup behavior to apply to every transition to/from silence. This can be useful for reducing transient artifacts during sudden changes in loudness.

2.2.3. Adaptive type

The adaptive type parameter allows adaptive startup and adaptive edges to be configured for Silence or adaptive threshold modes. Silence mode will only reset the loudness window when the input signal is silent. Adaptive threshold mode will reset the loudness window when the input signal crosses the configured adaptive threshold.

2.2.4. Adaptive threshold

The adaptive threshold parameter allows you to configure the threshold used by adaptive edges in adaptive threshold mode. This threshold is specified in the same units as the current loudness type.

2.3. Visualization

The visualization tab contains parameters related to real-time configuration of the meter's visualizations. This section describes these various settings.

2.3.1. Auto range

The auto range parameter enables or disables the visualization's auto range finding capabilities. This feature operates by analyzing the continuous histogram at each frame to determine a reasonable range for that moment in time. This range is then followed and adjusted smoothly over time.

2.3.2. Visual range presets

Visual range presets are provided for convenience as an example set of industry related loudness ranges.

Currently, the following visual range presets are available:

- Auto Range (Global)
- Auto Range (Per Panel)
- Standard Reference (>= -60)
- Full Range (>= -70)
- Custom Range ...

2.3.3. Loudness range

The loudness range parameter allows the visualization loudness range to be set manually. In order for this range to be enabled and used, the visual range presets parameter must be set to "Custom Range"

> Note that there are separate loudness ranges for windowed loudness types and peak loudness types.

> See range sliders for information about range sliders in general.

2.3.4. Snapshots

The snapshots feature allows you to take a snapshot of the current histogram. This can be useful for comparing histograms.

Each source/target/output signal has its own snapshot. The snapshots are persisted with plug-in state, so they will be available when you reopen the project.

Snapshots can be operated using the popup menu or via keyboard shortcuts.

The following snapshot parameters are available:

- Save/clear snapshot (saves or clears the current histogram)
  - Source = Cmd + 1
  - Target = Cmd + 2
  - Output = Cmd + 3
- Fill snapshot (fills the area under the snapshot)
  - Source = Cmd + Alt + 1
  - Target = Cmd + Alt + 2
  - Output = Cmd + Alt + 3
- Show/hide snapshot (shows or hides the snapshot in the visualization)
  - Source = Cmd + Shift + 1
  - Target = Cmd + Shift + 2
  - Output = Cmd + Shift + 3

> On Windows, use Ctrl instead of Cmd.

2.3.5. Layout options

The options menu allows you to configure the layout of the visualization. The following options are available:

- layout source mode : Specifies the layout mode for the source signal.
- layout target mode : Specifies the layout mode for the target signal.
- layout output mode : Specifies the layout mode for the output signal.
- raster type : Specifies the type of raster visualization.
- raster orientation : Specifies the orientation of the raster visualization.
- show thresholds : Specifies whether or not to show thresholds.
- show statistics : Specifies whether or not to show loudness statistics.
- show peak meter : Specifies whether or not to show peak meter.
- show history peak : Specifies whether or not to show history peak hold.
- show axis labels : Specifies whether or not to show loudness axis labels.
- show axis lines : Specifies whether or not to show loudness axis lines.
- show param context : Specifies whether or not to show parameter context while certain parameters are changing.

> Each layout mode has an AUTO option which automatically selects the best layout mode based on the current context.

2.3.6. Layout source mode

The layout source mode parameter allows you to configure the layout of the visualization's source panel.

Currently, the following layout source modes are available:

- None (No source panel is displayed)
- Auto (Automatically selects the best layout mode based on the current context)
- Source only (Draws just the source signal)
- Source over Target (Draws the target signal first, then the source signal on top)
- Source over Output (Draws the output signal first, then the source signal on top)

2.3.7. Layout target mode

The layout target mode parameter allows you to configure the layout of the visualization's target panel.

Currently, the following layout target modes are available:

- None (No target panel is displayed)
- Auto (Automatically selects the best layout mode based on the current context)
- Target only (Draws just the target signal)
- Target over Source (Draws the source signal first, then the target signal on top)
- Target over Output (Draws the output signal first, then the target signal on top)

2.3.8. Layout output mode

The layout output mode parameter allows you to configure the layout of the visualization's output panel.

Currently, the following layout output modes are available:

- None (No output panel is displayed)
- Auto (Automatically selects the best layout mode based on the current context)
- Output only (Draws just the output signal)
- Output over Source (Draws the source signal first, then the output signal on top)
- Output over Target (Draws the target signal first, then the output signal on top)

2.3.9. Delta field type

The delta field type parameter allows you to specify the type of delta field used by the visualization.

The delta field is basically a mapping from each source pixel on the screen to a destination pixel. Pixel shaders are used to iteratively apply this delta field using interpolation and some light dithering effects. This feature is purely for aesthetic purposes and has no effect on the audio.

> Raster type effects are drawn into the delta field on each frame.

2.3.10. Bits per pixel

The bits-per-pixel parameter determines the number of bits per pixel to use when rendering visualizations. The default bpp is the best performing. You can increase bpp to improve visual quality.

2.3.11. Milk Mode

The "Milk mode" parameter enables/disables milk mode. In milk mode, the visualizations will look smoother and behave more like a screensaver at the expense of accuracy. This feature is purely for entertainment purposes.

2.3.12. Bar Mode

The "Bar mode" parameter enables/disables bar mode. In bar mode, the visualizations will be drawn as vertical bars instead of sloped lines. This feature is purely for aesthetic purposes and has no effect on the audio.

2.3.13. Bucket size

The bucket size parameter determines the size in pixels of visualization buckets (rectangles).

2.3.14. Histogram hold

The histogram hold parameter enables or disables “hold” mode for the histogram raster types. While “hold” mode is enabled, the histogram will continuously accumulate measurements indefinitely. This can be used to capture a full duration view of your source audio. This allows you to easily adjust ranges to target to a specific region of the full dynamic range.

The histogram will still continuously accumulate measurements while “hold” mode is disabled, but for each new measurement the oldest measurement in history is replaced. This results in a continuously evolving histogram of duration specified by the history length parameter.

2.3.15. Delta X/Y/T

The delta X/Y/T parameters are provided to the visualization delta field in order to manipulate the delta field in real-time. The exact behavior of each parameter depends on the active delta field type.

2.3.16. Delta field

The delta field parameter allows you to enable or disable the visualization delta field.

The delta field is basically a mapping from each source pixel on the screen to a destination pixel. Pixel shaders are used to iteratively apply this delta field using interpolation and some light dithering effects. This feature is purely for aesthetic purposes and has no effect on the audio.

> Raster type effects are drawn into the delta field on each frame.

2.3.17. Shader params

The shader parameters control various aspects of visualization rendering. The following options are available:

- Shader param 1: Delta field fade rate. Lower values leave longer trails.
- Shader param 2: Curve fill transparency. Lower values make the curve more transparent, leaving only the edge(s) visible.
- Shader param 3: Curve edge thickness. Lower values make the edge thinner.

2.3.18. Show thresholds

The show thresholds parameter allows you to enable or disable threshold drawing in the visualization.

If this option is disabled, thresholds will still be drawn while changing the associated parameters.

> Thresholds are defined by the target range parameter.

2.3.19. Panel params

The panel parameters control various aspects of panel rendering. The following options are available:

- Panel param 1: Panel alpha (transparency), 0.0 to remove panel completely
- Panel param 2: Panel hue (rotates through normal, source, target, output).
- Panel param 3: Panel hue intensity

2.3.20. History length

The history length parameter allows you to change the duration of visualization history. This history is a rolling-window where each new loudness sample pushes out the oldest sample, maintaining a continuous history length with the duration you've configured here. Note that this setting applies both to history and histogram raster types.

> During histogram hold the histogram has an effectively infinite history length.

2.3.21. Show statistics

The “Show statistics” option allows you to show or hide the loudness statistics text overlay.

2.3.22. Show peak meter

The show peak meter parameter allows you to enable or disable peak meter drawing next to the visualizer.

2.3.23. Show history peak

The show history peak parameter allows you to enable or disable peak hold drawing for history raster visualizations.

> This option is only shown while the active raster type includes history.

2.3.24. Show axis labels

The show axis labels parameter allows you to enable or disable axis drawing in the visualization.

> The axis is scaled relative to the loudness range, which can be manual or auto range.

2.3.25. Show axis lines

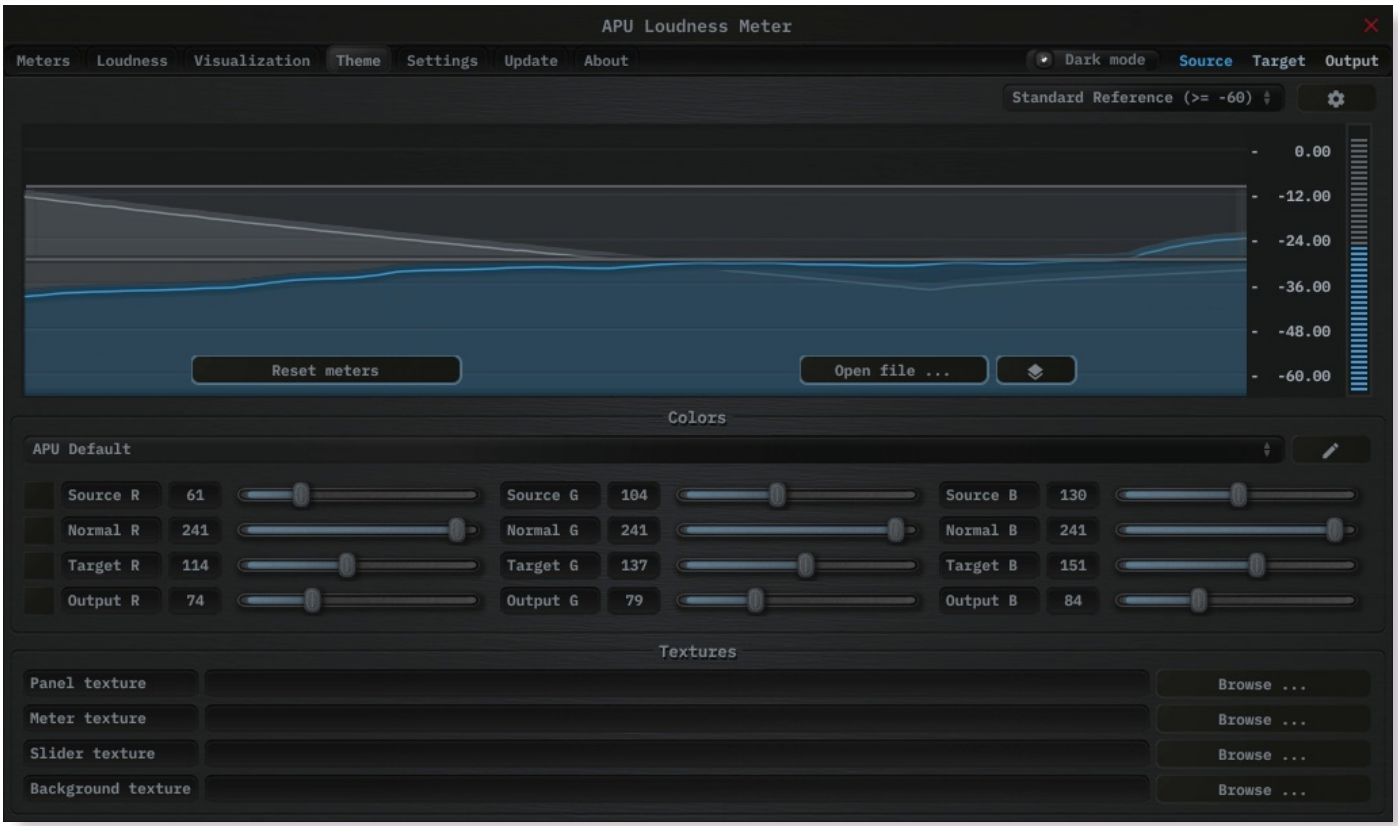
The show axis lines parameter allows you to enable or disable axis line drawing in the visualization.

> axis lines are drawn at each Show axis labels.

2.3.26. Show param context

The show param context parameter allows you to enable or disable param context text bubbles during parameter changes.

2.4. Theme



The theme tab contains parameters related to color themes. Here you can select between the bank of color theme presets, or configure the individual colors yourself.

2.4.1. Theme presets

The theme presets combo-box allows you to switch between a variety of theme presets. Each theme has a light and dark variation. Switching between theme presets will load values into source color, normal color, target color and output color.

Currently, the following themes are available:

- APU Default
- APU Red
- APU Vermilion
- APU Orange
- APU Amber
- APU Yellow
- APU Lime
- APU Chartreuse
- APU Harlequin
- APU Green
- APU Erin
- APU Spring
- APU Aquamarine
- APU Cyan
- APU Turquoise
- APU Azure
- APU Cerulean
- APU Blue
- APU Indigo
- APU Violet
- APU Purple
- APU Magenta
- APU Raspberry
- APU Rose
- APU Crimson

2.4.2. Source color

The source color parameters control the red, green, and blue components of the source color.

The source color is used in a variety of contexts, from interactive widgets to visualization elements. This color signifies that an element relates to the source signal in some way. This color is expected to contrast against the normal color to some extent.

2.4.3. Normal color

The normal color parameters control the red, green, and blue components of the “normal” color.

The normal color is used in a variety of contexts, from interactive widgets to visualization elements. This color signifies that an element is essentially neutral, not related to source, target or output signal. This color is expected to contrast against the source color, target color, and output color to some degree.

2.4.4. Target color

The target color parameters control the red, green, and blue components of the target color.

The target color is used in a variety of contexts, from interactive widgets to visualization elements. This color signifies that an element relates to the target signal in some way. This color is expected to contrast against the normal color to some extent.

2.4.5. Output color

The output color parameters control the red, green, and blue components of the output color.

The output color is used in a variety of contexts, from interactive widgets to visualization elements. This color signifies that an element relates to the output signal in some way. This color is expected to contrast against the normal color to some extent.

2.4.6. Textures

The textures configuration allows you to change the user interface textures.

The panel texture is used for the background of the user interface and has the shader params applied. The meter texture is used to fill the visualization effects. The background texture is used throughout the plug-in for shading.

These settings are stored with user scope, so you don't need to change them with every instance. Closing a texture will reverted to the default internal texture.

> Typically, the panel texture should be very dark and the meter texture should be very light.

2.5. Settings

The settings tab contains various additional parameters. These parameters are broken down between General and Latency parameters. Since Latency parameters impact delay compensation, changes to these parameters are deferred until you click the Apply button. It is generally not advisable to automate the parameters in the Latency section.

2.5.1. BPM

The bpm option allows you to set the BPM used by tempo-relative parameters.

2.5.2. Host BPM

The host bpm option enables usage of the host's BPM for tempo-relative parameters. When disabled, the bpm parameter is used instead.

> This parameter is not available (nor applicable) to the standalone application.

2.5.3. Velocity sensitive knobs

If enabled, this will turn on velocity-sensitive dragging, so that the faster the mouse moves, the bigger the movement to the knobs. This helps when making accurate small-scale adjustments.

> This parameter is saved at user scope, so it will be remembered between sessions.

2.5.4. UI Scaling

The UI scaling option allows you to set the scaling of the user interface. This is useful for high-DPI displays, where the default scaling may be too small to read comfortably.

> This parameter is saved at user scope, so it will be remembered between sessions.

2.5.5. Axis Scaling

The axis scaling option allows you to set the scaling of the axis ticks, labels and text bubbles. This is useful for high-DPI displays, where the default scaling may be too small to read comfortably.

> This parameter is saved at user scope, so it will be remembered between sessions.

2.5.6. Dark mode

The dark mode toggle enables/disables dark mode. When enabled, theme colors have their brightness inverted.

2.5.7. Gain change write

The gain change write mode controls how the plug-in publishes the latest signed gain change to the host as an automatable parameter. This can be useful for recording the plug-in's gain changes directly to an automation lane when supported by the DAW.

> Disabled turns gain change write off.

> Native uses the format-native write path when available. For non-VST3 plug-ins, Native falls back to the same behavior as Compatibility.

> Compatibility uses the generic host-notify write path, which may work in more places but is less elegant than Native when the host supports the native path.

> Host support for plug-in generated automation varies. When supported, put the host into Write or Touch mode and record the Gain Change Write parameter.

> Gain change write is output-only. The recorded automation lane is not read back into the plug-in's processing.

2.5.8. Blocksize

The block size parameter determines the time resolution of the meter's loudness measurements. Generally speaking, lower block sizes will give more accurate results. However, lower block sizes also require more CPU resources, so it is necessary to find a balance. You can squeeze improved quality and/or performance out of the meter by tuning this setting based on your available CPU resources.

> BPM units for block size are evaluated once at the time you press Apply.

2.5.9. Delay compensation

The delay compensation parameter determines whether or not the plug-in will report latency to the host. Delay compensation is used by hosts to keep audio synchronized across channels.

> The delay compensation option is not available (nor applicable) to the standalone application.

2.6. Update

The update tab allows you to check for the latest product versions. Just click “Check for updates” to see the latest version numbers. If you’re not running the latest version, you can click “Download” to open the download page in your default browser.

2.7. About

The about tab contains basic information about the plug-in.

3. Standalone CLI

APU Loudness Meter’s standalone application exposes a small user-facing command-line interface for loading, saving, and resetting standalone preset files. This section documents the supported options only.

Supported options:

- `--help` prints the supported standalone CLI options and exits.
- `--resetParams` resets parameters after the standalone app loads its remembered state.
- `--loadPreset="<path>"` loads a preset file before the window is shown.
- `--savePreset="<path>"` writes the resulting preset file and exits without opening the user interface.

Processing order:

- The standalone app first loads its normal remembered standalone state.
- If `--resetParams` is present, a full parameter reset is applied.
- If `--loadPreset` is present, that preset file is loaded next.
- If `--savePreset` is present, the resulting state is written to disk and the app exits immediately.

Examples:

- `<standalone-app> --help`
- `<standalone-app> --savePreset="C:\Temp\meter-startup.preset"`
- `<standalone-app> --resetParams --savePreset="C:\Temp\meter-reset.preset"`
- `<standalone-app> --loadPreset="/tmp/meter-session.preset"`
- `<standalone-app> --loadPreset="/tmp/meter-session.preset" --savePreset="/tmp/meter-copy.preset"`

Compatibility:

- `--loadPreset` and `--savePreset` use the same file format as the standalone app’s standard JUCE options-button commands, `Save current state...` and `Load a saved state...`.
- These file-based presets store the full standalone processor state. They are different from the in-app presets combo-box, which loads the product’s built-in preset entries and user preset-list selections.

4. Glossary

This section defines some of the concepts used within the software.

4.1. Range sliders

Range sliders are used throughout the plug-in in order to specify the upper and lower boundaries of a range. These ranges can be controlled via mouse in various ways.

- Click and drag the lower thumb to adjust the minimum value.
- Click and drag the upper thumb to adjust the maximum value.
- Click and drag the region between slider thumbs to move both values. This allows you to adjust the average loudness without expanding/contracting the dynamic range.
- Ctrl + click and drag the region between slider thumbs to expand/contract range without changing the average (center) value. Drag the mouse up and down, left and right are ignored.
- Shift + click and drag the region between slider thumbs to combine both. Drag the mouse up and down to expand/contract range. Drag the mouse left and right to move both values.

4.2. History

One of the primary views into your audio that this software provides is real-time history. The history view maintains a recent history of loudness measurements, continuously displaying them in FIFO order. This view helps you understand how the signal is changing over time, in real-time. History length and bucket size can be configured dynamically without forcing the history to reset.

4.3. Histogram

One of the primary views into your audio that this software provides is a real-time histogram. Histograms in general provide a quick and intuitive way to understand the relative frequency of different measurements. This is very useful when judging the overall dynamic range of the audio. The histogram provided by this software is capable of changing history length, bucket size and size continuously.

4.4. Source

The term “source” is used throughout the plug-in to identify the plug-in’s input source signal. This signal is represented in the user interface by the current theme’s source color.

4.5. Target

The term “target” is used throughout the plug-in to identify the configured target range loudness. This signal is represented in the user interface by the current theme’s target color.

4.6. Output

The term “output” is used throughout the plug-in to identify the output type signal. This signal is represented in the user interface by the current theme’s output color.

5. Credits

This software was developed by APU Software, LLC and is available as VST (windows x64/x86, macOS universal), Audio Unit (macOS universal), Pro Tools AAX (windows x64, macOS universal), or Standalone Application (windows x64/x86, macOS universal). The software libraries below are utilized for portions of the software:

- JUCE (cross-platform audio and user interface framework)
- Boost (header-only algorithms)
- libebur128 (loudness measurements)
- melatonin_blur (blur effects)

Demo video song credits:

- Annasara - A Lifetime Rolls By, licensed via Audiio

5.1. MIT License (libebur128)

5.2. MIT License (melatonin_blur)