



AUDIO SIGNAL PROCESSOR Æ€ OPERATIONS MANUAL

AMALGATONE

HYBRID DYNAMICS & ANALOG COLORATION WORKSTATION



SOFTWARE VERSION
v1.0.0 (Release)

TARGET
ARCHITECTURE
64-bit VST3 / AU

LATENCY ENGINE
0 Samples (Zero-Latency)

DEVELOPER
oTonami (G. Bonapace)

Global Interface Anatomy & Control Map

Amalgatone combines vintage analog compression physics with modern surgical control across a high-contrast 1060 × 690 px tactile bay. Below is the indexed global control map:



1

Header Bar & Preset Station

Top Bar

Global state management, 15ms click-free master bypass (ACTIVE button), preset browser, XML user preset import/export, and session state persistence.

2

Spectrum & Split-Band Crossover

Upper Bay

Real-time logarithmic RTA with 30-band 1/3-octave harmonic addition bars. Features 4th-Order Linkwitz-Riley Low/High crossover cutoffs with draggable markers.

3

Circuit Style Morpher

Center-Left

Continuous hardware topology interpolator moving smoothly between FET (0.0), OPTO (1.0), and TUBE (2.0) with real-time percentage blend readout.

4

Dynamics & Transfer Curve

Mid-Left

Threshold, Ratio (with stepped hardware snapping), Knee width, and an interactive real-time compression curve graph displaying input vs output slope.

5

Ballistics & Auto-Gain Stage

Lower-Left

6

Analog Coloration Engine

Center-Right

Precision Attack and Release ballistics, analytical Gaussian-weighted Auto Gain, output makeup gain trim, and parallel Dry/Wet crossfade.

Independent non-linear saturation bay: Drive push, Impact presence, 2nd-order asymmetric Warmth, 800 Hz Tone tilt EQ, and Color Delta solo mode.

7 Precision Metering Station

Far-Right Bay

True-peak digital readouts and responsive vertical bar meters for Input Peak (-60 to 0 dBFS), Gain Reduction (0 to -24 dB), and Output Peak with overload warning.

1. Header Bar, Preset Management & Master Bypass

Located across the top edge of the interface, the Header Bar handles session-wide operations, instant preset recall, and seamless A/B comparison.

Master Bypass Button (ACTIVE / BYPASS)

Click-Free Crossfade

Clicking the **ACTIVE** button toggles the entire plugin between active processing and true bypass.

Equal-Power Crossfade DSP: Unlike traditional DAWs that abruptly cut digital streams causing audible clicks, Amalgatone executes a dedicated **15 ms equal-power linear crossfade** (smoothedBypass). This allows producers to toggle bypass during live playback without interrupting audio.

Preset Station & Preset Management

XML Persistence

- Previous / Next Buttons (< / >):** Instantly cycle backward and forward through available presets.
- Preset Name Display Button:** Displays currently loaded configuration. Clicking opens a menu with:

Menu Command	Function & Behavior
Save User Preset	Prompts for a custom name and writes a portable .amgpreset XML file to user disk storage.
Save as User Default	Locks the current parameter state as the permanent startup state for every new plugin instance opened in your DAW.
Reset to Factory Default	Instantly reverts all controls back to the clean baseline (Clean Studio profile).
Import / Export Preset	Opens the OS file browser to share custom preset files with friends, collaborators, and clients.

The 9 Calibrated Factory Presets

Preset Name	Target Source	Key Parameter Settings & Sonic Purpose
Default (Clean Studio)	Clean Mix / Utility	FET clean baseline, 4:1 ratio, 20ms attack, full-spectrum, transparent leveling.
Opto Vocal Leveler	Lead Vocals / VO	Pure Opto 1.0, 3:1 ratio, Auto Gain ON, low-cut @ 80 Hz to eliminate microphone proximity rumble.
Punchy Drum Bus	Drum Busses & Loops	Fast FET 0.0, 4:1 ratio, 1.5ms attack, 65ms release, 85% mix, 55% drive for percussive smack.
Master Glue (Hybrid)	Stereo Master Bus	Hybrid 1.5 (Opto/Tube blend), gentle 2:1 ratio, 30ms attack, 200ms release, subtle warmth body.
Snare Smash & Crack	Acoustic/Trap Snares	Stepped 8:1 ratio, 0.8ms blistering attack, 45ms release, 70% parallel mix, 70% drive bite.

Preset Name	Target Source	Key Parameter Settings & Sonic Purpose
Warm Tube Bass	Bass Guitar & 808s	Tube 2.0, 4:1 ratio, 15ms attack, 180ms release, 85% warmth, high-cut @ 8 kHz to remove fizz.
Acoustic Guitar Polish	Acoustic Instruments	Hybrid 0.5 (FET/Opto), 3:1 ratio, 18ms attack, 120ms release, +25 Tone tilt for high-end shimmer.
Brickwall Limiter	Peak Control / Loudness	FET 20:1 ratio, 0.2ms microsecond attack, 35ms release, 0 dB hard knee for aggressive transient ceiling.
Analog Saturator	Harmonic Coloration	Tube 2.0, 85% drive, 75% warmth, 50% parallel blend (solo saturation mojo without heavy dynamic clamp).

2. Real-Time Spectrum Visualizer & Split-Band Crossover

Spanning the top bay (1020 Ã— 240 px), this section provides immediate visual feedback on incoming dynamics and harmonic coloration while offering phase-coherent split-band frequency isolation.

Real-Time Spectrum RTA & Harmonics

Order 11 FFT

- Clean Input Curve (Gray):** Displays the uncompressed, uncolored input frequency spectrum (-60 dB to 0 dBFS).
- Colored Output Curve (Neon Gradient):** Displays the processed output spectrum. The color dynamically adapts to circuit style: **Cyan for FET**, **Magenta for Opto**, and **Warm Gold for Tube**.
- 30-Band 1/3-Octave Harmonic Addition Bars:** Vertical peak-held bars tracking saturation energy boost (+0 to +12 dB scale on the right).
- CHART: ON / OFF Button:** Completely deactivates the FFT engine for 0% extra CPU consumption on large DAW session templates.

Split-Band Crossover Filters

Linkwitz-Riley LR4

- LOW: OFF (bandLow, 20 Hz â€” 20 kHz):** High-pass crossover. Frequencies *below* this point bypass compression and coloration completely, protecting sub-bass punch.
- HIGH: OFF (bandHigh, 20 Hz â€” 20 kHz):** Low-pass crossover. Frequencies *above* this point pass untouched, preserving natural vocal air.
- FULL SPECTRUM (Reset):** Restores full 20 Hz â€” 20 kHz processing with a single click.
- Interactive Chart Dragging:** Hover your mouse over the vertical cutoff lines (20Hz or 20k) and click-and-drag horizontally to sweep boundaries.

DSP Mathematics: 4th-Order Linkwitz-Riley (LR4) Phase Coherence

Phase Coherent

Standard crossovers introduce phase cancellation dips when summed back together. Amalgatone implements 4th-order Linkwitz-Riley dual crossovers with two fundamental acoustic guarantees:

Magnitude Flatness: $|H_{LP}(j\omega) + H_{HP}(j\omega)| = 1.0$ (0 dB flat gain across boundary)

Phase Alignment: $\angle H_{LP}(j\omega) - \angle H_{HP}(j\omega) = 2\pi$ (360Â° phase difference = 0Â° in-phase summing)

When split-band processing is active, the dry signal splits into subSample (< bandLow), targetBand (compressed & colored), and airSample (> bandHigh). Summing these outputs produces completely flat magnitude response with zero phase smearing.

Studio Pro-Tip â€” Protect Your Low End: If a loud kick drum or deep 808 sub is causing your compressor to over-react and pump the entire mix, raise **BAND LOW** to **60 Hz â€” 100 Hz**. Your sub-bass will punch through 100% uncompressed and clear, while the compressor clamps only the body of the snare and mix.

3. Circuit Style Morpher (Topology Engine)

The central breakthrough of Amalgatone: dissolving the historical boundaries between classic hardware circuits into a single continuous-state engine.

Style Slicer Slider (style, 0.0 to 2.0)

Continuous Morph

Drag the horizontal slider across the topology continuum. As you slide, Amalgatone recalculates attack acceleration, release curves, knee compliance, dynamic ratio slopes, and saturation polynomials in real time.

Style Mode Switch (HYBRID vs. SNAP)

Behavior Lock

HYBRID:

Continuous floating-point morphing (e.g., 44% FET / 56% OPTO).

SNAP:

Locks strictly to whole numbers: 0.0 (FET), 1.0 (OPTO), or 2.0 (TUBE) for instant classic hardware recall.

The Three Core Circuit Topologies

FET (0.0)

Solid-State

- Inspiration:** Iconic UREI 1176 style.
- Harmonics:** Symmetrical 3rd-order odd harmonics with aggressive transient bite.
- Ballistics:** Accelerated attack (down to 50 microseconds). Clamps transients with lightning speed.
- Knee:** Sharp, focused transition knee (0.75x width factor).
- Best For:** Drum bus punch, aggressive snares, percussive bite, parallel smash.

OPTO (1.0)

Electro-Optical

- Inspiration:** Classic Teletronix LA-2A style.
- Harmonics:** Asymmetrical 2nd-order even harmonics with soft parabolic clipping.
- Ballistics:** CdS photocell release memory. Fast recovery initially, switching to a slow secondary tail.
- Knee:** Wide, musical soft knee (1.15x width factor).
- Best For:** Lead vocals, voiceover, acoustic guitars, invisible transparent leveling.

TUBE (2.0)

Variable-Mu Triode

- Inspiration:** Fairchild 670 / Manley Vari-Mu.
- Harmonics:** Dense combination of 2nd & 3rd harmonics with low-end saturation body.
- Dynamic Ratio:** Progressive slope. Ratio steepens as signal pushes deeper beyond threshold.
- Knee:** Expansive soft knee (1.50x width factor).
- Best For:** Stereo master bus glue, bass guitar, synth sub warmth, full mix cohesion.

Dynamic Linear Interpolation Formulation

DSP Mathematics

For any decimal position $s \in [0.0, 2.0]$, Amalgatone computes normalized weights:

```
If  $s \leq 1.0$ :  $w_{FET} = 1.0 - s$ ,  $w_{OPTO} = s$ ,  $w_{TUBE} = 0.0$ 

If  $s > 1.0$ :  $w_{FET} = 0.0$ ,  $w_{OPTO} = 2.0 - s$ ,  $w_{TUBE} = s - 1.0$ 
```

The effective knee width, attack acceleration, and transfer curve are computed as continuous linear combinations of these weights, preventing phase shifts or stepping artifacts.

4. Dynamics Section, Ballistics & Auto Gain

Located in the lower-left bay, this section provides comprehensive control over the compression curve, response speeds, level compensation, and parallel dry/wet blending.

Dynamics Controls

Curve Shaping

THRESHOLD	-60.0 to 0.0 dB	Sets the level where compression begins. Lower values clamp deeper into the body.
RATIO	1.0:1 to 20.0:1	Gain reduction slope applied to signals exceeding threshold.
STEP BUTTON	Stepped / Free	Toggles snapping to classic steps: 2:1 , 4:1 , 8:1 , 12:1 , 20:1 . Scroll mouse wheel over knob to cycle.
KNEE	0.0 to 20.0 dB	0 dB = hard knee (aggressive transient limiting); >6 dB = soft parabolic transition (invisible leveling).

Interactive Transfer Curve Window

Real-Time Visualizer

A dedicated display window rendering the input/output gain transfer function (-60 to 0 dBFS):

- Horizontal Axis:** Input signal in dBFS.
- Vertical Axis:** Compressed output signal in dBFS.
- Real-time Curve:** Updates instantly as you adjust Threshold, Ratio, Knee, and Circuit Style (illustrating Tube ratio curvature).

Ballistics & Output Stage

Timing & Level

Knob / Button	Range / Default	Engineering Function & Production Implication
ATTACK	0.1 ms to 200.0 ms (10 ms)	Controls how fast gain reduction engages. Fast times (<2ms) tame harsh transients; slow times (>20ms) let transient punch through.
RELEASE	10 ms to 1200 ms (100 ms)	Speed of recovery back to unity. Fast release (<50ms) pumps room energy; slow release (>200ms) delivers transparent glue.
AUTO GAIN	Toggle Button	Enables real-time analytical loudness compensation (see formula below). Eliminates psychoacoustic volume bias.
MAKEUP	-12.0 to +24.0 dB (0 dB)	Manual output gain trim. When Auto Gain is active, this knob functions as an offset fine-trim.
DRY / WET	0.0% to 100.0% (100%)	Equal-power crossfade between dry input and processed output for immediate parallel New York-style compression.

Analytical Auto-Gain: Gaussian Numerical Integration

Smart Loudness Lock

Traditional plugins use crude approximations ($GR \approx \sqrt{\text{Threshold} / 2}$) that fail on soft knees and variable ratios. Amalgatone executes an analytical profile across 40 dBFS of musical dynamic range:

Weight Distribution: $w(x) = \exp(-0.5 \cdot ((x - (-16.0)) / 8.0)^2)$ [Centered at -16 dBFS RMS]

Ballistics Modifiers: $F_{att} = 1.0 - 0.22 \cdot (\ddot{I}_{att} / (\ddot{I}_{att} + 18))$ | $F_{rel} = 0.85 + 0.15 \cdot (\ddot{I}_{rel} / (\ddot{I}_{rel} + 120))$

This guarantees level-matched auditioning regardless of extreme threshold and ratio settings.

5. Dedicated Analog Coloration Engine & Metering Bay

Located in the center-right panel (outlined in vibrant neon amber), the Coloration Engine is an independent harmonic saturation matrix designed to inject authentic analog warmth and texture.

Coloration Module Toggles

Control Switches

- COLOR: ON / OFF Button:** Master enable switch for the harmonic saturation module, operating independently from dynamics.
- DELTA: ON / OFF Button:** Auditions the **pure isolated harmonic saturation** generated by the engine. Strips away the fundamental audio signal so you can judge added distortion with zero guesswork.
- Circuit Style Badge (e.g., HYBRID | 44% FET / 56% OPTO):** Real-time readout of active saturation transfer profiles.

Harmonic Sculpting Knobs

4 Rotary Knobs

DRIVE	0% to 100%	Pushes audio into non-linear transfer curves (saturates earlier).
IMPACT	0% to 200%	Scales harmonic amplitude and loudness in the final mix.
WARMTH	0% to 100%	Adds DC-bias skew for thick 2nd-order even harmonics.
TONE	-50 to +50	800 Hz hinge tilt EQ (vintage warmth to crisp top-end sheen).

Coloration Signal Flow & DC Protection

DSP Architecture

Audio entering the coloration engine traverses four sequential mathematical processing stages:

- Non-Linear Waveshaping:** Samples are pushed through topology-dependent transfer functions (FET odd harmonics, Opto even harmonics, Tube blend).
- Asymmetrical DC Bias:** The *Warmth* control introduces controlled offset bias to generate musical even-order chest resonance.
- 800 Hz Tone Tilt Filter:** A 1-pole low-pass/high-pass filter network tilts harmonics without altering fundamental audio phase.
- Discrete Leaky DC Blocker:** High-order even saturation produces DC drift. A recursive high-pass filter ($y[n] = x[n] - x[n-1] + 0.9995 \cdot y[n-1]$) eliminates DC offset with zero audible low-frequency phase distortion.

Precision Metering Station

Metering Elements (Far-Right Bay)

Real-Time Safe

Meter	Digital Readout	Scale & Ballistics	Visual Indicator Function
IN	-60.0 to 0.0 dBFS	Fast Peak Response	Tracks raw incoming stereo audio peak level before processing.
GR	0.0 to -24.0 dB	Peak Hold & Exponential Decay	Downwards-pointing amber bar showing active dynamic attenuation.

Meter	Digital Readout	Scale & Ballistics	Visual Indicator Function
OUT	-60.0 to 0.0 dBFS	Fast Peak + Clip LED	Monitors output signal. Active red overload warning triggers if signal exceeds 0 dBFS.

6. Studio Production Recipes & Power-User Shortcuts

Recipe 1: In-Your-Face Lead Vocal

Opto + Warmth

- **Style:** OPTO (1.0) | **Ratio:** 3.0:1 | **Knee:** 6.0 dB
- **Attack:** 35 ms | **Release:** 280 ms | **Auto Gain:** ON
- **Band Low:** 80 Hz (cuts mic rumble)
- **Color:** Drive 30%, Warmth 65%, Tone +15 (air sheen).

Recipe 2: Aggressive Punchy Drum Bus

FET Smack

- **Style:** FET (0.0) | **Ratio:** 4.0:1 stepped | **Knee:** 0 dB
- **Attack:** 1.5 ms | **Release:** 65 ms | **Mix:** 85%
- **Band Low:** 65 Hz (protects sub-kick punch)
- **Color:** Drive 55%, Impact 120%, Tone +10.

Recipe 3: Warm Master Bus Glue

Hybrid 1.5

- **Style:** Hybrid 1.5 (Opto/Tube) | **Ratio:** 2.0:1 | **Knee:** 8 dB
- **Attack:** 30 ms | **Release:** 200 ms | **Auto Gain:** ON
- **Color:** Drive 15%, Warmth 40%, Tone 0, Impact 90%.
- **Result:** Smooth cohesive glue without squashing peaks.

Recipe 4: Saturated 808 & Bass

Split-Band Tube

- **Style:** TUBE (2.0) | **Ratio:** 4.0:1 | **Knee:** 4.0 dB
- **Attack:** 15 ms | **Release:** 160 ms
- **Band Low:** 90 Hz (sub passes clean and uncompressed!)
- **Color:** Drive 70%, Warmth 80%, Tone -15 (fat low-mids).

Power User Mouse Actions & Shortcuts

Action	Target Control	Function & Result
Double-Click	Any Rotary Knob or Slider	Instantly resets parameter to factory default setting.
Ctrl / Cmd + Drag	Any Rotary Knob	Engages ultra-fine precision decimal adjustment mode.
Mouse Wheel Scroll	STEP Button or Ratio Knob	Quickly cycles through classic stepped ratios (2:1, 4:1, 8:1, 12:1, 20:1).
Shift + Drag	Ratio Knob (when Stepped)	Temporarily bypasses step snapping for smooth continuous tuning.
Click & Horizontal Drag	Low / High Cutoff Markers	Sweeps Linkwitz-Riley split-band crossover frequencies on visualizer chart.

System Specifications & Compatibility

Supported Formats	VST3 (64-bit), AU (macOS Universal - coming soon), Standalone Application
Sample Rates	44.1 kHz, 48.0 kHz, 88.2 kHz, 96.0 kHz, 176.4 kHz, 192.0 kHz
Processing Latency	0 Samples (Zero-Latency) – Ideal for live tracking and low-latency monitoring.
Windows VST3 Path	C:\Program Files\Common Files\VST3\Amalgatone.vst3
License & Royalties	100% Free – Full commercial rights (commercial mixing, film scores, sound design).

