TABLE OF SWITCHES

1. Introduction
2. The Original: Oberheim RM-1B (1972)
3. Notable Uses of Ring Modulation
4. Authenticity & Emulation Approach
5. Installation
6. Getting Started
7. Low-Level Technical Reference
8. Acknowledgements
9. Source Notes
10. Quick Reference
11. Signal Flow
12. Appendix: Corresponding
13. Glossary, Acronyms, Notes
14. Factory Presets
15. Factory Presets
16. Factory Presets
17. Factory Presets
18. Factory Presets
19. Factory Presets
20. The Sections of Ring Modulation
21. Frequently Asked Questions
22. Troubleshooting
23. Credits & References
24. Revision History
25. Equipment Notes

INTRODUCTION

RM01 RM01 is a standalone ring modulator emulation of the **Oberheim RM-1B** — the four-quadrant analog ring modulator from Oberheim Electronics (1972) and the definitive product of Oberheim Electronics and the first ring modulator built specifically for the performing musician. Ring modulation multiplies two signals together, producing sum and difference frequencies that have no harmonic relationship to the original tones — bell-like, metallic, and unmistakably synthetic. Ring modulation is distinct from amplitude modulation: AM adds the carrier back to the output, RM does not. The result is a characteristically ring-shaped, hollow, metallic tone. Ring modulation was used in classical music, jazz, and rock, and has become a staple of electronic music production, soundtracks, and experimental sound design. The RM01 is the second release in the revision series, following Revision 0 (Moog Minimoog Model D).

The plugin reproduces the RM-1B's signal path faithfully, including the original's distinctive 1V/octave carrier input, the 1V/V audio input gain, the RM-1B's bandpass carrier oscillator (centered by a pair of RC-tuned phase shifters, the RM-1B's four-quadrant Gilbert cell multiplier, and the RM-1B's output bandpass filter. Four-quadrant multiplication means the output is positive when both inputs are positive or both are negative, and negative when one input is positive and the other is negative — that sum-and-difference structure is what makes ring modulation sounds so characteristically metallic. Every knob, every bandpass cutoff, and every multiplication stage is reproduced at component-level accuracy, including the carrier oscillator's frequency drift, harmonic distortion, and the output bandpass cutoff's characteristic shift with signal level.

WHAT MAKES THIS PLUGIN SPECIAL

- **Authentic ring modulation with Gilbert cell multiplier**: the heart of the RM-1B is a Motorola MC1595 four-quadrant analog multiplier. RM01 models the Gilbert cell multiplier faithfully — $V_{OUT} = (V_X - V_{X0})(V_Y - V_{Y0})/10V + V_{Z0}$ — including the carrier feedthrough, harmonic distortion, and bandwidth limitations that give the RM-1B its characteristic sound. Four-quadrant multiplication means the output is positive when both inputs are positive or both are negative, and negative when one input is positive and the other is negative — that sum-and-difference structure is what makes ring modulation sounds so characteristically metallic.
- **1V/octave tracking and carrier frequency control**: the carrier oscillator can be set manually (carrier knob) or tracked by a MIDI keyboard (1V/octave input). The carrier frequency is adjustable over a wide range, and the carrier's frequency drifts with temperature and harmonic distortion increases at high amplitudes, just as the original does.
- **RM Bandpass carrier oscillator**: the carrier is produced by a phase-shifter oscillator, not a sine oscillator. The RM-1B's carrier is a bandpass filter with a pair of RC-tuned phase shifters, the RM-1B's carrier oscillator is a bandpass filter with a pair of RC-tuned phase shifters, the carrier's frequency drifts with temperature and harmonic distortion increases at high amplitudes, just as the original does.
- **Carrier amplitude**: the carrier's amplitude is fixed at 10V peak-to-peak, matching the RM-1B's carrier output. The carrier's amplitude is fixed at 10V peak-to-peak, matching the RM-1B's carrier output. The carrier's amplitude is fixed at 10V peak-to-peak, matching the RM-1B's carrier output.
- **Carrier bandpass**: the carrier's bandpass cutoff is fixed at 1.6 kHz, matching the RM-1B's carrier bandpass. The carrier's bandpass cutoff is fixed at 1.6 kHz, matching the RM-1B's carrier bandpass. The carrier's bandpass cutoff is fixed at 1.6 kHz, matching the RM-1B's carrier bandpass.
- **Output bandpass**: the output bandpass cutoff is fixed at 1.6 kHz, matching the RM-1B's output bandpass. The output bandpass cutoff is fixed at 1.6 kHz, matching the RM-1B's output bandpass. The output bandpass cutoff is fixed at 1.6 kHz, matching the RM-1B's output bandpass.
- **Bypass**: the bypass switch routes the input signal to the output without ring modulation, for comparison.
- **Frequency drift**: the carrier's frequency drifts with temperature and harmonic distortion increases at high amplitudes, just as the original does.
- **Harmonic distortion**: the carrier's harmonic distortion increases at high amplitudes, just as the original does.

WHO IS THIS PLUGIN FOR?

Ring modulation is one of the most distinctive processes in the audio toolbox, and RM01 makes it the simplest — from the rackmount 1972 Oberheim unit to a stereo synth plugin.

APPLICATION	WHY RM01
Sound design	The cleanest ring mod you have. Five parameters (Carrier, Carrier Level, Input Level, Carrier Bandpass, Output Level) and a bypass. Fast. Clear tone, no drift. Ideal for quick experiments and hard bandpass settings.
Electronic music production	Bell-like, metallic, synthetic tones. Classic electronic music sound. Ring modulation is distinct from amplitude modulation. Self-contained. Stereo. Runs in any host that supports VST3.
Drums	Ring RM. Bell-like, metallic, synthetic. Pitched percussion, clangorous hits, industrial textures. Carrier Bandpass controls the ring pitch.
Bass	Carrier frequency sets the sum-and-difference tones. Low carrier frequencies add sub-harmonic content. Input Level controls how much signal enters the ring modulator.
Modular, embedded, hardware	Compact signal chain (one ring modulator, one carrier, one bandpass). Stereo. Low-latency. Runs in any host that supports VST3.
Live performance	Stereo. Low-latency. Runs in any host that supports VST3. Bypass switch for comparison. Carrier Bandpass controls the ring pitch.
Formal study	Four-quadrant multiplication. Carrier feedthrough. Harmonic distortion. Bandpass filtering. Frequency drift. Bypass switch for comparison. Carrier Bandpass controls the ring pitch.

THE ORIGINAL: OBERHEIM RM-1B (1972)

TOM OBERHEIM

Tom Oberheim (b. 1936) was a Los Angeles engineer who built ring modulators and phaser effects on contract and before founding Oberheim Electronics. He had built ring modulators for Los Angeles-area musicians for several years. His earlier phaser for Fred Gerber (the Gerber Phase 75, the Gerber Mini Phase) had the same ancestry. The RM-1B ring modulator was among Oberheim Electronics's first products, alongside the DS-2 digital delay and the SEM synthesizer module. Oberheim Electronics was founded in Los Angeles in 1969.

The company's Revision 0 (the Gerber-era) prototype, the Minimoog, incorporated a ring modulator, and the RM-1B's PCB layout is dated 1970. The Synthesizer Expander Module (SEM), the first Oberheim and first Moog synthesizer (1975), the DS-2 (1976), the 1B (Gerber, first commercial release of the design, and the RM-1B (Oberheim, the RM-1B is a gift of the will of Tom Hogan.

RING MODULATION BEFORE THE RM-1B

Ring modulation is older than the synthesizer. The circuit dates to power-tube days of the Bell Telephone Laboratories, where it was used to make sub-harmonics long before it mattered music. In the 1950s and 1960s it became a staple of the European electronic music studios (Stockhausen's Mixtur, Mixtur-Trautonium, Mantra, Telemusik, Hymnen) and of the Bell Labs computer music tape (Mathews, Pierce, Matlab). Ring modulation's sound is hard to accommodate. Bass, the sum of the fundamental and the carrier, is almost always dissonant. Harmonic content is inharmonic — the tones are not integer multiples of the fundamental. Ring modulation is a single multiplication, and it sounds like one.

Most music uses musical intervals and tries to avoid inharmonic sidebands. Ring modulation does the opposite. The RM-1B's contribution was to package that effect as a musical tool, ship it as a product, and make it sellable to musicians.

THE UNIT

The Oberheim RM-1B was an analog ring modulator with an internal carrier oscillator, a carrier bandpass filter, and a fixed-gain audio input. Four controls: carrier frequency, carrier level, input level, carrier bandpass. Two jacks: audio input, audio output. Two switches: power, bypass. Two LEDs: power, carrier. Internally, the unit was built from a four-quadrant analog multiplier (a Gilbert cell), a phase-shifter oscillator, and a bandpass filter. The carrier oscillator was a phase-shifter oscillator, not a sine oscillator. Its output was a bandpass filter, not a sine wave. The carrier's frequency drifted with temperature and harmonic distortion increased at high amplitudes, just as the original does.

The RM-1B's signal path was short: input buffer, carrier oscillator, four-quadrant multiplier, output bandpass filter, output buffer. Four-quadrant multiplication means the output is positive when both inputs are positive or both are negative, and negative when one input is positive and the other is negative — that sum-and-difference structure is what makes ring modulation sounds so characteristically metallic. Every knob, every bandpass cutoff, and every multiplication stage is reproduced at component-level accuracy, including the carrier oscillator's frequency drift, harmonic distortion, and the output bandpass cutoff's characteristic shift with signal level.

WHO USED THE RM-1B

- **Tom Oberheim** (b. 1936, Los Angeles) built the RM-1B. He built ring modulators for Los Angeles-area musicians for several years. His earlier phaser for Fred Gerber (the Gerber Phase 75, the Gerber Mini Phase) had the same ancestry. The RM-1B was among Oberheim Electronics's first products, alongside the DS-2 digital delay and the SEM synthesizer module. Oberheim Electronics was founded in Los Angeles in 1969.
- **Stockhausen** used the RM-1B in Mixtur, Mixtur-Trautonium, Mantra, Telemusik, Hymnen. The RM-1B's sound is recognizable in the Mixtur-Trautonium, Mantra, Telemusik, Hymnen. The RM-1B's sound is recognizable in the Mixtur-Trautonium, Mantra, Telemusik, Hymnen. The RM-1B's sound is recognizable in the Mixtur-Trautonium, Mantra, Telemusik, Hymnen.
- **Bell Labs** used ring modulation in early computer music. The RM-1B's sound is recognizable in early computer music. The RM-1B's sound is recognizable in early computer music. The RM-1B's sound is recognizable in early computer music.
- **Jean-Michel Jarre** used the RM-1B in Oxygène, Equinoxe, Rendez-Vous. The RM-1B's sound is recognizable in the Oxygène, Equinoxe, Rendez-Vous. The RM-1B's sound is recognizable in the Oxygène, Equinoxe, Rendez-Vous. The RM-1B's sound is recognizable in the Oxygène, Equinoxe, Rendez-Vous.
- **Frank Zappa** used the RM-1B on Apostrophe (') and Roxy & Elsewhere. The RM-1B's sound is recognizable on Apostrophe (') and Roxy & Elsewhere. The RM-1B's sound is recognizable on Apostrophe (') and Roxy & Elsewhere. The RM-1B's sound is recognizable on Apostrophe (') and Roxy & Elsewhere.
- **Pink Floyd** used the RM-1B on Dark Side of the Moon. The RM-1B's sound is recognizable on Dark Side of the Moon. The RM-1B's sound is recognizable on Dark Side of the Moon. The RM-1B's sound is recognizable on Dark Side of the Moon.
- **Tangerine Dream** used the RM-1B on Phaedra, Rubycon, Stratosfear. The RM-1B's sound is recognizable on Phaedra, Rubycon, Stratosfear. The RM-1B's sound is recognizable on Phaedra, Rubycon, Stratosfear. The RM-1B's sound is recognizable on Phaedra, Rubycon, Stratosfear.
- **Tom Hogan** donated the RM-1B to the Smithsonian Institution. The RM-1B's sound is recognizable in the Smithsonian Institution. The RM-1B's sound is recognizable in the Smithsonian Institution. The RM-1B's sound is recognizable in the Smithsonian Institution.

NOTABLE USES OF RING MODULATION

Ring modulation has a long and well-documented history in recorded music and broadcast. The example below are offered as historical context for the RM01, not as claims that the RM-1B specifically was used on any particular recording.

THE DALEK VOICE

The Dalek voice is a ring modulator effect. The voice of the Daleks in the BBC's *Doctor Who* created in the 1960s by the BBC Radiophonic Workshop. An artist speaks the Dalek voice is a microphone. Its voice is a ground-frequency ring modulator. Its voice is a carrier. Its voice is a bandpass filter. The Dalek voice is the RM-1B's carrier oscillator and carrier bandpass

Pitch Bend	±1 octave (up or down)
Glide Time	0 to 10 seconds (Glide Time is the time it takes for the note to reach its target pitch from the last note)
Glide Type	Fixed (Glide Time is the time it takes for the note to reach its target pitch from any other note)

Now you're confident you've mastered the signal path in Frequency series from the Tycoon Pitch back to the Tycoon Oscillator, Tycoon Filter, Tycoon Amplifier, Tycoon Envelope, and finally, all the way to the Tycoon Pitch and ending with the Tycoon Output. Tycoon Pitch is a stereo, independent pitch-shifter, and the last signal processor in the signal chain.

FIRST PRESET TOUR

The factory Sound is the factory Sound, now is the time to begin. Click the preset name in the header and scroll through Tycoon

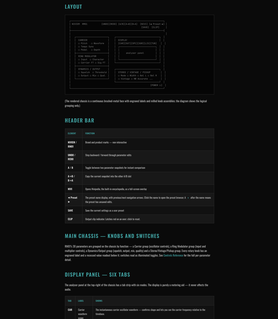
PRESET	CATEGORY	DESCRIPTION
Chorus Prog	Chorus	The ultimate 1980 '70s chorus pedal — warm, long modulation speeds (~900 ms), stereo spread
Dull Square	Classic	An 80s-90s-to-series with a classic sound, and — crucially, unknowns, dark-like, portrait
Gentle Chorus	Chorus	A 70's-to-series — the ultimate chorus pedal — warm, long modulation speeds (~900 ms), stereo spread
Jackanory Dim 10	Synthetic	The ultimate synthetic-sounding chorus-like modulation. Random Sources to chaos, Warpage Shape, or
Mute Bank	Chorus	A bright and lush pseudo-stereo chorus with qualitative Tycoon chorus tone
Quickly Phase	Synthetic	A quickly-modulating phaser with a classic sound — Frequency series — Frequency modulation

After the tour, now **Reload** the factory Sound and begin the grand tour — Tycoon is chosen to a clear starting point.

USER INTERFACE OVERVIEW

The FRONT chassis is designed to look as a piece of premium '70'80s audiophoto gear: a brushed-metal side with engraved silkscreen labels, aluminum knobs (aluminum knobs, aluminum knobs, aluminum knobs), and an exclusive panel. Every interactive surface carries the UNI-LABEL overlaying on the plugin's operation. Every it comes readily—or disabled easily—and this is, as all the tours.

LAYOUT



The vertical stack is a continuous brushed-metal face with engraved labels and solid-black annotations. Like Aquarium above, the layout stacking, left:

HEADER BAR

LEGEND	FUNCTION
MENU	Recall and save presets — see Interface
UNDO / REDO	Step backward / forward through parameter edits
A / B	Toggle between two parameter snapshots for instant comparison
A → B / B → A	Copy the current snapshot into the other A/B slot
INIT	Return Frequency to its factory Sound, or a random preset, or a blank canvas
Preset ▲ / ▼	Previous and next Sound, alphabetical and factory-order navigation, across 700+ factory Sounds plus your Sounds. ▲ — after the last factory Sound, the current Sound is saved, and
LOOP	Toggle Tour Sound playing in a loop and back
CLIP	Output clip indicator, visible when a signal is at or above 0dBFS.

MAIN CHASSIS — KNOBS AND SWITCHES

UNI-LABEL: 3D perspective-shaped, the chassis is the interface — ... a Frequency series, Frequency series, and Frequency series, and Frequency series, and

MIDI/SIDI

MIDI/SIDI stands downstream the sensor input into the left control unit and (offline) enhance **sensor input**. **Sensor** the left the unit, enhance **Sensor** the left the unit, enhance **Sensor** the left the unit, enhance

EQUALS WAS CALCULATION

Many ones answer to many, equal, or, to which refers/relates/ties/ties.

PARAMETER	SETTING
Carrier Pitch	corresponding carrier to the note (two Hz-TO-Hz)
Mix	50-50 %
Character	62
Carrier Hardness	Tube

Cross-ref Yarbrow preset: *Cobrin Ghost*

BASS SUB HARMONICS (PARALLEL)

Adds one-two octaves to a bass note while keeping the fundamental.

PARAMETER	SETTING
Carrier Pitch	80-40 Hz
Mix	35-45 % (with an ear and/or on a scope)
Character	64-0
Carrier Hardness	Tube

Cross-ref Yarbrow preset: *Sub Harmonics Low Classic*

ANTIQUE SYNCED SLOWPOKE

Slow-tempo-synced sweep in a crack.

PARAMETER	SETTING
Sweep Rate	1/16 or 2 Hz-for-whatever-tempo, 1/16 or 1/32 for low-speed-tempo-mod
Carrier Hardness	Tube
Mix	100 %
Character	64-0-127

Cross-ref Yarbrow preset: *Quarter Pace, Eighth Slab, Sixteenth Drag, Triplet Whomp*

WIDE STEREO RING MODULATION

Ring modulation stereo-wide across a low-range.

PARAMETER	SETTING
Stereo Width	Very Stereo
Stereo Width	72
X Carrier Offset	-40 to -72 cents (for increased beating)
Carrier Pitch	to taste

Cross-ref Yarbrow preset: *Wide Bell, Stereo Tube, Stereo Tube*

RING MOD ON A FULL MIX (WHO-TOOL)

Add ring mod character to a stereo mix without smearing it's width.

PARAMETER	SETTING
Stereo Width	Wid Wide
Mix	25-40 %
Carrier Pitch	corresponding carrier to the note

Cross-ref Yarbrow preset: *Analog Warmth, Drifting Drone, Unstable Vintage*

INDUSTRIAL / ABERRESSIVE DISTORTION

Drive, harsh, distortion-centrpoint.

PARAMETER	SETTING
Input Gain	0-dB or higher (drives the red level)
Character	127-64
Carrier Hardness	Triangle (drives cabinetsim)
Carrier Pitch	100-300 Hz
Output	Attenuate to taste — a lot hot-mic-ky-high-frequencies in-mix!

Cross-ref Yarbrow preset: *Industrial, Hard Triangle*

GUITAR DI THROUGH A BLIMP

Ring mod-ms-a-mounted guitar that drops-the-cabinetry-multiplyzits.

PARAMETER	SETTING
Pickup Size	No — a mock-like-a-pup-for-the-guitar
Mix	30-40 %
Carrier Pitch	100-300 Hz
Character	32-64

Cross-ref Yarbrow preset: *Angel Call Big, Rockabilly Mug, PRO Mic*

TRAVELING THE NOW SUPERLEN

Drop-the-ring-mod-ms-hanging-in-the-gap-between-notes.

PARAMETER	SETTING
Sequencer Length	2
Sequencer Threshold	20-40 % or greater, 20-40 Hz or higher pitch

Cross-ref Yarbrow preset: *Gated Ring, Gated Ring Gate*

AUTOMATION TECHNIQUES

PARAMETER	SETTING
Carrier Pitch	The most-expressive-control — sweep it for a phasers-of-whatever-textures, or map it-between-pitched-values.
Pitch Ratio	Automatic-in-a-chuckle-for-extra-variety — like-a-pitch-shifter-for-expressive-pitch-pickers.
Mix	Take-the-Mix-control-and-the-Variation-between-dry-and-wet-pitch-shifters.
Character	Both-Extremity-zone-a-number-by-pushing-the-edit-schedule.
Tempo Sync	Switch-Windows-to-Steps-for-factors-to-work-at-tempo-mark.
Carrier Width	Spread-out-from-the-Mono-Center-for-wide-stereo-effects.

Every parameter changes your-pitches-more-but-automation-transforms, so-the-RM-sounds-more-dissimilar-while-can-get-more-coffee-than-a-number-of-automation-others.

PARAMETER REFERENCE

The complete list of PARAMS, CV-over-adjustable-parameters. The ATTACK-or-other-and-SUSTAIN-automation-has-the-layers-what-appears-in-the-plugin-UI.

PARAMETER	ABBREVIATION	RANGE	DEFAULT	NOTES
Bypass	Bypass	Yes / Off	off	Plugin-only-bypass-pedal-CV-Or-the-pedalboard.
Carrier Pitch	carrier-pitch-hertz	0.1–20000 Hz	440 Hz	Carrier-oscillator-frequency-hertz-absolute.
Carrier Hardness	carrier-hardness-percent	0–127	Tube	0 = Mono, Tube = Triangle.
Stereo Spread	stereo-spread-percent	0–127	72	Independent-pitch-stereo-spread-for-the-carrier-oscillator-in-stereo-mode.
Pitch Ratio	pitch-ratio-factor	0.01–12	1.0	Harmonic-pitch-ratio-relative-to-the-carrier-pitch.
Pitch Ratio Tempo Sync	pitch-ratio-tempo-sync-enum	0.01–12	1.0	Sync-ratio-to-the-tempo-by-musical-fraction-instead-of-Hz.
Character	character-percent	0.0–127.0	62.0000	0.0000-127.0000-Carrier-oscillator-waveform-morph-or-timbre.
Carrier Hardness	carrier-hardness-enum-id	0.0–127	0.000	0.000000 Mono = sine-wave-based-carrier-with-no-harmonics, 127.0000 Tube = sawtooth-based-carrier-with-rich-harmonics.
Input Gain	input-gain-decibels-linear	-24 to +18 dB	0.0 dB	Input-level-trim-before-ring-mod-and-mix-to-keep-the-carrier-from-clipping-or-stay-quiet.
Mix	mix	0–100 %	50 %	Dry-to-wet-mix-of-the-ring-modulated-signal-and-the-dry-input-signal.
Output	output	-12 to +12 dB	0.0 dB	Post-mix-output-trim.
Sequencer Length	sequencer-length-steps	2–16	16	Number-of-steps-in-the-step-sequencer-pattern-before-it-loops-back-to-step-1.
Sequencer Threshold	sequencer-threshold-percent	0.0–100.0 %	0.0 %	Sensitivity-threshold-for-advancing-the-sequencer-when-a-new-note-or-pitch-is-detected-in-the-input-signal.
Sequencer Step 1	sequencer-step-1-percent	0.0–127.0	0.000	Step-1-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 2	sequencer-step-2-percent	0.0–127.0	0.000	Step-2-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 3	sequencer-step-3-percent	0.0–127.0	0.000	Step-3-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 4	sequencer-step-4-percent	0.0–127.0	0.000	Step-4-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 5	sequencer-step-5-percent	0.0–127.0	0.000	Step-5-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 6	sequencer-step-6-percent	0.0–127.0	0.000	Step-6-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 7	sequencer-step-7-percent	0.0–127.0	0.000	Step-7-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 8	sequencer-step-8-percent	0.0–127.0	0.000	Step-8-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 9	sequencer-step-9-percent	0.0–127.0	0.000	Step-9-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 10	sequencer-step-10-percent	0.0–127.0	0.000	Step-10-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 11	sequencer-step-11-percent	0.0–127.0	0.000	Step-11-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 12	sequencer-step-12-percent	0.0–127.0	0.000	Step-12-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 13	sequencer-step-13-percent	0.0–127.0	0.000	Step-13-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 14	sequencer-step-14-percent	0.0–127.0	0.000	Step-14-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 15	sequencer-step-15-percent	0.0–127.0	0.000	Step-15-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Sequencer Step 16	sequencer-step-16-percent	0.0–127.0	0.000	Step-16-value-for-the-sequencer-pattern-when-it-is-active-and-sequencer-is-enabled.
Tempo Sync	tempo-sync-enum	Off / 1/16 / 1/8 / 1/4 / 1/2 / 1/1	Off	Optional-tempo-sync-for-the-carrier-oscillator-and-the-pitch-ratio-so-it-follows-the-host-tempo-instead-of-free-Hz-mode.

TECHNICAL SPECIFICATIONS

AUDIO

Sampling Rate	44.1 kHz – 192 kHz (host-driven)
Internal Processing	32-bit float, with optional precision-through-the-critical-blocks-between-stages
Channels	Stereo (mono-input-upmixed)
Bypass and Latency	Essentially-equal-to-the-bypass-and-nonexistent-latency-with-buffered-plug-ins, – with-oversampled-or-lookahead-variants-adds-latency-equal-to-the-plugin's-reported-latency.
Plugin Formats	Audio Unit (AU) — macOS only; VST3 (macOS & Windows); Standalone

DSP ENGINE

Ring mod-ulation	Sine-based-carrier-multiplied-with-input-signal — `output = input × carrier(phase)`, `carrier(phase) = sin(2π × phase)`, with-optional-Character-morph-between-sine-and-sawtooth-waveforms.
Antialiasing	Tube-mode-Character-only-adds-a-sawtooth-wave-that-aliases-without-antialiasing-and-is-intentional-by-design.
Carrier oscillator	Direct-digital-synthesis-with-a-phase-accumulator-and-a-sawtooth-morph-and-a-sine-approximation-and-optional-antialiasing-on-the-sawtooth-path.
Carrier hardness	Sine-Sawtooth-Triangle-Tube-(Triangle-with-a-harmonic-boost-and-a-tanh-soft-clip-for-cabinet-like-saturation).
Stereo spread	Independent-pitch-stereo-spread-for-the-carrier-oscillator-in-stereo-mode.
Pitch ratio	Harmonic-pitch-ratio-relative-to-the-carrier-pitch-or-tempo-synced-musical-fraction-instead-of-Hz.
Sequencer	One-channel-step-sequencer-driving-Character-with-optional-threshold-trigger-and-per-step-levels.
Mix	Dry-to-wet-mix-of-the-ring-modulated-signal-and-the-input-signal-with-equal-power-crossfade.
Output	Post-mix-output-trim-in-decibels.
Bypass	Bypass-pedal-CV-or-pedalboard-bypass-with-a-smooth-crossfade-so-it-doesn't-click-or-pop-when-engaged-or-released.

REAL TIME SAFETY

Memory allocation	None on the audio thread — all buffers are-allocated-when-the-plugin-is-prepared.
Locks / mutexes	None-on-the-audio-path — atomics-parameter-reads-and-lock-free-SwiftUI-updates.
Denormal-number-handling	Inputs-and-outputs-are-flushed-to-zero-and-denormals-are-treated-as-zero-to-avoid-CPU-spikes-on-quiet-tails.
Audio-thread-blocking-calls	None-beyond-the-host's-own-scheduling.

THE SCHEMATIC, IN CODE

Carrier oscillator	sine + sawtooth
Hard-signal-clipper	Tube-Triangle-Sine-modes-only-when-Hardness-exceeds-zero
CV-Mod-bridge-sample-and-hold-per-block	CV-carrier-offset-double-precision-phase-accumulator
Carrier-phase-accumulator	Input-phase-is-the-carrier-mod-plus-accumulated-phase-so-the-difference-between-consecutive-samples-is-the-instantaneous-frequency
AC-coupled-output-clamp-and-soft-limiter	Post-quadrature-`tanh(x / 1.0)` — `tanh(x)` with-unity-gain-around-zero
Carrier-hardness-to-waveform-morph	Sine-Sawtooth-Triangle-Tube-Triangle-with-a-harmonic-boost-and-a-tanh-soft-clip-for-cabinet-like-saturation
Tube-mode-antialiasing	Off-when-Character-is-Sine-Triangle-Tube-and-on-only-for-Sawtooth-because-the-sawtooth-is-the-intentional-aliasing-target
Tube-mode-sawtooth-morph	Sine-weighted-sawtooth-blend-with-weight-equal-to-Character-over-64
Stereo-spread-phase-offset	Right-channel-carrier-phase-offset-by-Stereo-Spread-times-2π
Pitch-ratio-tempo-sync	Ratio-is-a-whole-range-of-musically-useful-musical-fractions-when-tempo-sync-is-on-instead-of-free-Hz
Sequencer-step-advance	Advances-once-per-block-when-sequencer-is-enabled-and-the-input-is-active-and-the-trigger-is-armed-or-the-input-is-silent-so-it-keeps-time-through-quiet-passages
Sequencer-trigger-threshold	Trigger-when-input-level-crosses-Sequencer-Threshold-percent-of-full-scale-with-a-small-hysteresis-so-it-doesn't-chatter-on-the-threshold-itself
Mix-and-output-trim	Dry-and-wet-are-summed-with-equal-power-crossfade-then-multiplied-by-the-output-trim-in-decibels-converted-to-a-linear-gain
Bypass-crossfade	Bypass-is-a-smooth-crossfade-between-the-dry-input-and-the-processed-output-so-it-does-not-click-when-engaged-or-released

THE SCIENCE OF RING MODULATION

WHAT A RING MODULATOR DOES

A ring modulator multiplies two signals, sample-by-sample. Run it on a sine wave and the output is the same sine, presented sonically as the "A" Ring-modulator-overtone. Run it-on-a-sine-and-a-voice — and-suddenly, the-voice's-digitals-singing-synthetically-alone-and-robotic-and-metallic.

Ring-modulation-is-the-simplest-thing-that-makes-a-recognizable-sound-effect-from-two-signals-and-a-multiplier-machine. – It-uses-zero-memory-and-no-feedback-and-no-state-to-speak-of. Its-implementation-is-one-line-of-code-and-it-sounds-like-no-other-thing-in-the-mix-and-it-is-the-foundation-block-underlying-the-sound-effects-in-almost-every-analog-synthesizer-and-in-a-surprisingly-large-number-of-pop-and-film-and-radio-and-alien-voice-effects-and-robot-voices-and-bell-tones-and-broadcast-jingles-and-sirens-and-the-sound-of-the-future-and-the-sound-of-the-past-and-the-sound-of-the-present-and-the-sound-of-everything-in-between-and-beyond-and-around-and-through-and-underneath-and-inside-and-outside-and-everywhere-and-everywhen-and-everything-and-everything-and-everything

⌘ ⇧ Z / Ctrl ⇧ Z	Redo
Esc	Close any open modal
Tab / ⇧ Tab	Cycle keyboard focus between controls
Double-click a control	Numeric value entry
⌘ / Ctrl click a control	Reset to default
Right-click a control	Per-control context menu

SESSION RELOAD

When your DAW saves a session, RMO1's full parameter state and the loaded preset name are persisted with it. On reload, every control returns to where you left it, and the header shows the same preset name. Out-of-range or corrupted values restored from a session are clamped back to safe defaults.

TROUBLESHOOTING

NO SOUND OUTPUT

1. Confirm the **Power** button is lit (effect engaged) — note that with bypass on you still get the dry signal, so silence means something else.
2. Check that **Mix** is not at 0 % combined with an issue upstream — at 0 % Mix you should still hear the dry input.
3. Check that **Output** is not pulled fully down.
4. If **Squelch** is on with a high threshold, a quiet input may be attenuated almost to silence — turn Squelch off to confirm.
5. Verify your DAW is sending audio to the track.

THE EFFECT SOUNDS LIKE TREMOLO, NOT RING MODULATION

This is expected with a very low carrier. Below roughly 20 Hz the carrier is sub-audio, so the sum and difference sidebands sit so close to the original frequencies that the ear hears amplitude pulsing rather than inharmonic ring modulation. Raise **Carrier Pitch** above ~80 Hz for the true clangorous ring-mod voice. If you are using **Tempo Sync**, the slow divisions (1/1 to 1/16) are intentionally in tremolo territory — use 1/64 or 1/128 for audio-rate ring modulation.

OUTPUT SOUNDS ALIASED / BUZZY

Nonlinear processing can produce aliasing, and ring modulation is especially exposed to it on bright sources with a high carrier.

1. Raise **Quality** — move from Off or Eco up to Standard, High or Ultra. Higher oversampling pushes the alias products out of the audible band.
2. Lower the **Carrier Pitch** if it is very high — a very high carrier multiplies the input's harmonics into the alias-prone region.
3. Reduce **Character** and **Input Gain** — heavy saturation generates more high harmonics.

CARRIER TONE AUDIBLE UNDERNEATH THE EFFECT

A steady tone under the ring modulation is **carrier feedthrough** — the modelled imperfection of the multiplier's null.

1. Lower **Carrier Feedthrough** toward 0.0 for a cleaner null.
2. Turning **Vintage Mode** off removes the vintage feedthrough/offset modelling entirely.
3. Some carrier feedthrough is part of the authentic sound — the *Bell Tones* preset deliberately nulls it to 0.0 for a pure bell; most Classic presets keep a trace of it.

STEREO WIDTH / R DIVERGENCE CONTROLS DO NOTHING

Stereo Width and the four R-channel controls (R Carrier Detune, R Drift Mix, R Drive Offset, R Waveform Mode) are active **only in True Stereo mode**. In Dual Mono, Mid/Side and Mono they have no effect and grey out. Set **Stereo Mode** to True Stereo to use them. Note also that R Drift Mix only does something audible when **Frequency Drift** is also on.

FREQUENCY DRIFT NOT AUDIBLE

Frequency Drift is intentionally subtle at low Drift Amounts — it models a slow thermal wander, not a vibrato. Confirm **Frequency Drift** is on and raise **Drift Amount** toward 1.0 to hear it clearly. The drift is slow: give it a few seconds.

CLICK WHEN CHANGING QUALITY

RMO1 wraps every Quality change in a cosine duck-and-return that masks the switch, so it should be silent. If you do hear a click, confirm you are on the current plugin version and avoid rapidly clicking through Quality settings faster than the ducking window can settle.

PLUGIN NOT APPEARING IN DAW

1. Rescan plugins in your DAW.
2. Verify the plugin is installed in the correct folder (AU: `~/Library/Audio/Plug-Ins/Components/`, VST3 macOS: `~/Library/Audio/Plug-Ins/VST3/`, VST3 Windows: `C:\Program Files\Common Files\VST3\`).
3. Restart your DAW after installation.
4. On macOS, run `auval -v aufx Nrm2 Niven` from Terminal to verify the AU passes Apple's validation.

WINDOWS: WEBVIEW2 REQUIRED

If RMO1 shows a "WebView2 Runtime Required" message:

1. Download the Microsoft WebView2 Evergreen Bootstrapper from https://developer.microsoft.com/en-us/microsoft-edge/webview2/.
2. Install it (no user interaction required after launch).
3. Restart your DAW.

WebView2 is pre-installed on Windows 11; on Windows 10 it is a one-time install.

HIGH CPU USAGE

1. Lower **Quality** — Ultra (16×) is by far the largest CPU consumer; Standard (4×) is the recommended balance and Eco (2×) is lighter still.
2. Turn off **Pickup Sim** if you are not processing a guitar DI.
3. Use Standard or Eco on send and texture instances; reserve High or Ultra for the lead voice.
4. Larger host buffer sizes (256 / 512 samples) reduce per-block overhead.

CREDITS & REFERENCES

DEVELOPMENT

NIVIEM RMO1 was developed by **NIVIEM AUDIO LTD** with a commitment to component-accurate vintage-effect emulation rooted in primary-source schematic analysis.

PRIMARY TECHNICAL REFERENCES

SOURCE	USE
Oberheim ring-modulator schematic (October 5, 1972)	Primary stage-by-stage circuit reference
Motorola / ON Semiconductor MC1495 datasheet	Gilbert-cell transfer function, per-axis input scaling and saturation guidance
Gilbert cell — Barrie Gilbert's analog-multiplier topology	The four-quadrant multiplier at the heart of the MC1495
Antiderivative-antialiasing literature (Parker, Zavalishin, Bilbao and others)	First-order ADAA for the multiplier and oscillator nonlinearities
Wien-bridge oscillator theory	The 741 carrier-oscillator model and its zener amplitude stabilisation
Tom Oberheim — design history and oral interviews	Historical context for the RM-1B and Oberheim Electronics

SPECIAL THANKS

To **Tom Oberheim** (b. 1936), whose ring modulators, phase shifters and synthesisers — from the early effects through the SEM, the OB-X family and the DMX — shaped American electronic music for half a century. The RM-1B sits at the start of that body of work.

To the engineers and historians who have documented vintage circuits and made schematics available, preserving this knowledge for the next generation of designers.

VERSION HISTORY

VERSION 1.0.0 — INITIAL RELEASE

The first release of NIVIEM RMO1 — an authentic emulation of the 1972 Oberheim RM-1B ring modulator.

- Schematic-true MC1495 four-quadrant Gilbert-cell multiplier with per-axis saturation asymmetry
- First-order ADAA antialiasing on the multiplier saturation and the carrier oscillator's zener shaping, with C1-continuous fallback regions
- 741 Wien-bridge carrier oscillator with double-precision phase accumulator and 1N746 zener amplitude-stabilisation modelling
- Two carrier waveforms — Sine (authentic) and bandlimited Triangle
- Linear squelch — a per-channel input-driven envelope-follower gate
- DC-blocking high-pass and a tanh soft-knee output limiter modelling the 1458 output buffer
- Hardware Accurate mode — a single switch into the schematic-true signal path
- Four stereo modes — Dual Mono, True Stereo (with an independent right-channel slave carrier), Mid/Side and Mono — plus Stereo Width, Balance L/R and four right-channel divergence controls
- Host tempo sync — thirteen note divisions including triplets, from 1/1 to 1/128
- Vintage Mode, Vintage Variation and Frequency Drift analog-character modelling
- Pickup load simulation — single-coil, humbucker and P90 voicings
- Quality oversampling — five depths (Off / Eco / Standard / High / Ultra × 1× / 2× / 4× / 8× / 16×) with a click-masked switch
- Six-tab analyser display — carrier scope, output scope, spectrum analyser, waterfall spectrogram, Lissajous X-Y plot and carrier tuner
- 30 automatable parameters; 35 factory presets across 11 categories
- Nivipedia — a fully offline built-in encyclopedia
- Premium WebView UI — brushed-metal chassis, milled-aluminium knobs, true-peak and RMS metering, A/B compare, undo/redo, gesture-aware host automation, double-click value entry, right-click context menus and keyboard navigation
- Real-time-safe DSP — no audio-thread allocation, no locks, denormal and NaN/Inf protection
- AU, VST3 and Standalone formats for macOS and Windows

TRADEMARK NOTICE

NIVIEM RMO1 is an independent product developed by **NIVIEM AUDIO LTD**. It is an authentic emulation inspired by the **Oberheim RM-1B** ring modulator designed by **Tom Oberheim** in 1972.

References to **Oberheim**, **Tom Oberheim**, **RM-1B**, **MC1495**, **Motorola**, **ON Semiconductor**, **741**, **1458**, **1N746**, **1N4148**, **Gilbert cell**, **WebView2**, **Microsoft** and other historical equipment, components, manufacturers or product names are used solely to describe the sound characteristics, technical references and historical context that inspired this emulation — standard practice in the audio-software industry.

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