P930 Lunar Lander – Spacial Instrument Comprehensive User Guide

Preface

P930 Lunar Lander elevates all the qualities we value in plate reverb and analog delay, while offering a level of control and refinement that invites engineers to explore space, motion, and harmonic detail with new precision.

A reverb is never defined by its sound alone. Its true worth is revealed by how naturally it blends into a mix, how gracefully it integrates into the musical landscape, and how effortlessly it extends the emotional expression of the source. From the outset, P930 was designed around this harmonizing philosophy, giving you a tool that is as intuitive as it is deep, as musical as it is technical.

Although inspired by classic plate algorithms and analog BBD delay circuits, Lunar Lander is not a tribute to a single machine or era. Its design reflects years of research into physical plate behavior, chamber acoustics, tape pre-delay workflows, and the nonlinearity of early digital reverbs.

The engine exposes parameters that most processors hide, not for complexity's sake, but because they are the very behaviors that make great reverbs feel alive: harmonic excitation, diffusion structure, micro-modulation, bandwidth shaping, phase interplay, and saturation-driven glue.

The Plate input stage responds musically to level, just like a physical metal sheet, allowing engineers to shape tone through gain rather than EQ. P930 captures the essential character of plate reverb, the charm of BBD analog delay, and the warmth of transformer-like output stages through a triple P42 saturation system—one saturator for the plate, one for the BBD module, and one for the output.

The plugin operates in both Modern and Vintage modes, extending the sonic reach of the BBD far beyond the limitations of physical bucket-brigade circuits when clarity is needed, while preserving the organic behavior of hardware when desired.

Beyond this, P930 offers adjustable bandwidth control for both the Plate and BBD engines, flexible module routing in series or parallel, a Ping Pong algorithm for left/right isolation, multiple wet/dry blend strategies through Mix Type selection, advanced ducking circuits, controllable noise, and the ability to behave either as a fully wet effect on a return track or as a sophisticated insert effect on individual sources.

Pulsar Modular tools traditionally come with a learning curve, because our engines do more than emulate recognizable reverb signatures—they provide the building blocks to create new ones. Our intention is always the same: to design instruments that will stay in your studio for years, inspiring new workflows rather than replicating old limitations.

P930 Lunar Lander continues that lineage. Its depth is not meant to overwhelm you, but to offer a sonic vocabulary wide enough for any engineer or producer to create exactly the space they imagine.

As you explore Lunar Lander, you will find that it navigates time, space, tone, and motion with effortless fluidity. It can sound physical and organic, digital and shimmering, dark and intimate, bright and modern, or surreal and atmospheric.

Whether you lean on its subtle harmonic shaping to bring life to vocals, use its plate engine for classic warmth, its BBD for analog motion, or its hybrid modes for cinematic ambience, P930 becomes not just an effect, but an extension of your artistic intent.

If you ever wondered whether you needed another reverb or delay processor, let Lunar Lander demonstrate its value—again and again—across every style of music, on every type of source, and in every stage of your mix.

It is a tool designed not to imitate space, but to help you shape it.

— **Ziad Sidawi**, Audio Equipment Designer & CEO Pulsar Modular

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1. Core Concepts & Unique Features

P930 is built around one concept: a hybrid of analog BBD delay, EMT-style plates, and Lexicon 224-style studio plates, designed to behave like hardware and respond musically to small adjustments.

1.1 Not a generic reverb

The plate is level-sensitive.

- **More input:** Brighter, splashier, metallic ripple.
- **Less input:** Warmer, smoother, more controlled.

This covers both EMT 140 traits and the tighter, more mix-ready feel of a Lexicon 224 plate.

1.2 Not a generic delay

The BBD stage is voiced like hardware: limited bandwidth, saturation, optional noise, and time modulation that behaves like real bucket-brigades.

1.3 Modern / Vintage extends the BBD beyond real hardware

This is a key P930 feature often missed.

- **Vintage mode** behaves like a true analog BBD: bandwidth limits, darker tone, time-related filtering, and optional clock noise.
- **Modern mode** removes the hard bandwidth ceiling and noise floor, allowing BBD-style modulation and tone at frequencies and clarity no physical BBD can achieve.

This is how P930 reaches cleaner U2-style repeats, wide chorus textures, and modern stereo flanging without collapsing into noise.

1.4 Flexible routing

- **Series:** Delay feeds Plate, like running a pedal into an EMT or 224 return.
- **Parallel:** Dry + Delay + Plate are blended inside the plugin, like console sends.

The character changes depending on where the dry signal is allowed to ride.

1.5 Small moves matter

Input gain, damping, bandwidth, saturation, and mix rules are calibrated so subtle adjustments translate directly into audible mix differences, not just intensity changes.

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2. Signal Flow & Architecture

P930 Lunar Lander contains three processing domains: **Plate Reverb**, **BBD Delay**, and the **Output Stage**. Each domain is independent, and their interaction is defined by the routing mode and mixing strategy you choose. This architecture allows the plugin to behave like classic EMT plates, Lexicon 224 plates, analog BBD devices, or modern hybrid designs.

2.1 Core Signal Paths

P930 operates in either Series or Parallel routing. These modes determine how Plate and BBD feed each other before reaching the output.

2.1.1 Series Mode

In Series, Plate and BBD are connected in sequence. The Module Order button selects which module comes first. There are two musically meaningful options:

- **Reverb → Delay → Output:** This is the routing used for EMT 140 style plates and many Lexicon 224 style chains in P930. The Plate establishes the spatial tone, and the BBD adds motion, smear, or halo around the reverb. Ideal for vocal plates, snare plates, and warm ambience.

- **Delay → Reverb → Output:** This resembles a pre-delay or tape echo feeding a reverb. The Delay shapes early reflections; the Plate transforms them into a continuous field. Useful for slapback into plate, rhythmic echoes into reverb, or modern insert chains.

Both Series routings are correct and intentionally available.

2.1.2 Parallel Mode

In Parallel, Dry, Plate, and BBD each run their own path and meet only at the output mixer.

- Dry remains untouched.

- Plate and BBD each contribute their wet signal.

- Mix Type determines how these components blend.

Parallel mode behaves like console send/return and is ideal for dub throws, wide modulation, and any situation where Reverb should not receive Delay.

2.2 Internal Processing Domains

- **Plate Reverb Domain:** Models physical and early digital plate behavior. Features include: level-dependent excitation, diffusion control, bandwidth shaping, modulation, three plate types, and dedicated saturation.

- **BBD Delay Domain:** Models analog bucket-brigade behavior with Modern and Vintage modes, tone filters, bandwidth control, modulation, regeneration, clock noise, and stereo offset options.
- **Output Domain:** Applies the P42-style saturation, final gain staging, and the selected Mix Type blend law.

2.3 Mix Type (Wet/Dry Blend Law)

Mix Type defines how Dry and Wet signals combine. Each curve has a musical purpose.

Mix Type	Description	Use Case
Linear	Authentic analog dry/wet behavior.	Essential for ADA, Boss BF-2, and accurate analog flanger designs.
Balanced	Slight loudness compensation.	Used for chorus, wide modulation, and dimension-style motion.
Sin3dB	Smooth, natural blend.	Commonly used for EMT 140 and Lexicon 224 plates, as well as dub throw presets.
Sin4.5dB	More forward and spacious.	Good for wide chorus and stereo modulation.
Sin6dB	Strong psychoacoustic lift.	Works for large ambient and cinematic effects.
SR Curves (3dB / 4.5dB)	Soft, vintage-feeling blends.	Effective for phasers, univibe, and older modulation tones.

Export to Sheets

In Series, Mix Type controls the final wet/dry blend. In Parallel, it shapes how Dry, Plate, and BBD sum together.

2.4 Stereo Behavior

Stereo width is influenced by BBD Offset L/R, Phase Flip, Plate diffusion characteristics, Mix Type, and summing mode. Small changes in these parameters have large impacts on image width and motion.

2.5 Modern vs Vintage Modes

The BBD domain operates in two tonal modes.

- **Vintage:** Limited bandwidth, darker tone, clock coloration, and analog drift.
- **Modern:** Extended bandwidth, no noise floor, and the ability to reach tones that physical BBD hardware cannot produce.

Modern is ideal for clean U2-style delay or wide flanging. Vintage is ideal for authentic chorus, phaser, and analog modulation tones.

2.6 Routing Summary

Routing	Dry	Plate	BBD	Interaction
Series: Reverb → Delay	untouched	processed first	delay receives plate	EMT and many 224 plates
Series: Delay → Reverb	untouched	receives delayed signal	delay feeds plate	slap into plate, rhythmic effects
Parallel	independent	independent	independent	console send/return

Export to Sheets

Both Series chains are musically valid. Choose the order based on how you want Plate and Delay to interact and which one should shape the space first.

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3. BBD Delay Module: Controls & Tone

The BBD section models an analog bucket-brigade delay, with control over tone, modulation, noise, and time. It can operate as a vintage effect or a clean modern delay depending on mode and filtering.

3.1 Delay Time (Clock Rate)

Delay time is set by the **Clock Rate** knob.

- **Low values** = longer delay
- **High values** = shorter delay

The time can be defined in **Milliseconds** (free mode) or **Tempo divisions** (sync mode).

- **Sync Mode ON:** The delay locks to the DAW tempo. Time is set by **Rhythm** and **Time Signature**. Milliseconds are not available, as with real synced delay units.
- **Sync Mode OFF:** The user can choose **Milliseconds** or **Beats-per-minute** (manual BPM mode, independent of DAW). This makes it possible to design **Johnny Cash slapback**, **rockabilly echo**, or any timing unrelated to the project tempo.

3.2 Tone Shaping Filters

The BBD has **HPF** and **LPF** that define the bandwidth of the delay.

- **Lower LPF** gives vintage darkness.
- **Higher LPF** gives modern clarity.
- **HPF** removes low-end smear and reduces mud.

Bandwidth Control: This parameter tightens or widens the effective filter span.

- **Low Bandwidth** = lo-fi, compressed, classic BBD.
- **High Bandwidth** = open, hi-fi modern tone. Bandwidth works in combination with the filters, giving very granular control over delay color.

3.3 Modulation

Two controls generate delay time modulation.

- **Rate:** Sets modulation speed (0.01 Hz for slow drift, 10 Hz for fast vibrato-style wobble).
- **Depth:** Sets the intensity of time variation (Small depth for chorus, larger depth for flange-style motion).
- **Offset Left / Right:** Applied after modulation, offsets each channel's base delay time. This is the core of stereo widening, ping-pong feel, and asymmetrical flange/chorus spread.

3.4 Regeneration (Feedback)

Controls how much of the delayed signal is fed back.

- **0 percent** = single echo
- **1–4 percent** = doubling, widening
- **5–20 percent** = slapback, tape-style repeats
- **High values** = resonant tones and self-oscillation

In **Modern Mode**, regeneration stays cleaner and more stable. In **Vintage Mode**, regeneration introduces filtering and saturation buildup.

3.5 Saturation

Adds level-dependent nonlinearities inside the delay line. Gives repeats more presence, helps delayed signal sit forward without raising its volume, and adds harmonic color typical of hardware delays. This parameter affects Wet Only, not the dry path.

3.6 BBD Noise

Emulates clock noise from real bucket-brigade chips.

- **Noise ON:** recreates vintage pedals and rack units.
- **Noise OFF:** opens high-end extension that real BBDs cannot achieve.

This is essential for realistic ADA, MXR, Boss BF-2, Mutron behaviors, as well as Clean U2 / The Edge delays and Modern chorus/flanger that need high clarity.

3.7 Phase Flip

Applies a 180-degree phase inversion to the delayed signal. Useful for stereo widening, avoiding low-end buildup, creating dimension-D style motion, and removing flanging artifacts accidentally created in chorus presets.

3.8 Power

Master bypass for the BBD section. When **OFF**, the delay is fully removed from the chain, and Plate receives the raw signal (in series mode) or the dry signal bypasses the delay (in parallel mode).

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4. Plate Module: Controls & Tone

The Plate section models three plate types inspired by classic EMT and Lexicon 224 plates. It reacts strongly to **input level**, filtering, and bandwidth; small changes reshape the sound in a musical way.

4.1 Plate Type

Three plate models are available.

- **Plate 1 (Short):** Shortest decay, tighter midrange, minimal low-end buildup. Ideal for vocals needing presence without bloom.
- **Plate 2 (Medium):** Medium decay, balanced tonality, recognizable EMT 140 character. Works for most vocal, snare, and acoustic material.
- **Plate 3 (Long):** Longest decay, open and airy. More like 224 plates with softer diffusion and cleaner top.

Changing plate type does not require XML editing; the plugin remembers the model internally.

4.2 Input Level (Reverb Input Gain)

The plate is **nonlinear with respect to input level**, just like metal sheets and 224 algorithms. This is one of the most important controls.

- **High input:** Excites the virtual plate, brightens the tone, adds metallic sheen, and can produce “ripple tail” vibrations.
- **Lower input:** Warmer, smoother, more forgiving on sibilant vocals.

This behavior is key to shaping “Sinatra warm” vs “Frank live” vs “pop modern” vocal plates.

4.3 Decay

Sets the length of the plate tail.

- **Short (1–2 seconds):** pop vocals, spoken word, fast songs.
- **Medium (2–4 seconds):** classic EMT vocal and drum plates.
- **Long (4–8 seconds):** ballads, synths, cinematic work. Plate 3 typically needs less decay because it is already more spacious.

4.4 Damping

Controls how much the high frequencies roll off over time.

- **Higher damping** = darker tail, 1970s EMT tone.
- **Lower damping** = brighter, more modern 224-like sound. Works together with LPF and Bandwidth.

4.5 Diffusion (Diff One / Diff Two)

Shapes the density and smoothness of the initial reflections.

- **Low diffusion:** more grain, more metallic.
- **High diffusion:** smoother, less resonant. The two parameters work together to control **attack** versus **tail density**.

4.6 Bandwidth

Defines the range in which the plate operates. This is **not a simple tone control**. Increasing bandwidth changes how the plate resonates in both frequency and stereo spread.

- **Low bandwidth:** darker, narrower, lo-fi, EMT vintage.
- **High bandwidth:** brighter, wider, more “digital plate” clarity.

4.7 HPF / LPF

Tone-shaping filters applied **to the reverb only**.

- **HPF:** prevents low-end bloom on vocals or drums.
- **LPF:** warms the tail, essential for vintage EMT tones. LPF combined with input gain defines most of the plate’s character.

4.8 Pre-delay

Separates the dry signal from the plate tail.

- **0–20 ms:** classic EMT vocal plate.
- **20–40 ms:** pop vocals, more depth.
- **50 ms+:** special FX, rhythmic phrasing.

4.9 Saturation

Applies harmonic excitation inside the reverb path. Helps plate stand out without raising volume and adds a gentle EMT-style grit. Works well for drums and bright vocals. Use lightly for crooner vocals, more for modern pop.

4.10 Mix

Reverb blend.

- **Insert use:** typical values 10–40 percent.
- **Send/return:** 100 percent wet.**Parallel mode ON** ensures only wet reverb reaches the summing stage.

4.11 Power

Turns the Plate section on or off. When off, in **series mode**, signal bypasses directly. In **parallel mode**, plate contributes nothing to the wet blend.

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5. Ducking & Dynamics Module

The Ducking System in P930 Lunar Lander is designed to keep effects musical, controlled, and out of the way of the source when needed. It allows reverb and delay to breathe around the signal instead of masking it.

Unlike traditional sidechain compressors, Lunar Lander's ducking is tightly integrated into the effect engine and tuned specifically for time-based processing.

5.1 Ducking Modes

The **Mode** selector determines which signal is reduced when ducking is active:

- **Delay** – Only the BBD delay is ducked
- **Reverb** – Only the plate reverb is ducked
- **Delay & Reverb** – Both effects are ducked together
- **Main Output** – The entire wet signal is ducked

This allows precise control depending on whether you want clarity on vocals, tighter echoes, or cleaner ambience.

5.2 Ducking Controls

The user-facing ducking controls are intentionally minimal:

- **Threshold**
  Sets the level at which ducking begins. Lower values trigger ducking more easily.
- **Ratio**
  Controls how strongly the effect is reduced once the threshold is crossed.
- **Release**
  Determines how quickly the effect returns after the input signal drops below the threshold.

Attack and Knee are internally tuned and not user-adjustable. They are optimized to sound natural across vocals, instruments, and rhythmic material without requiring technical setup.

5.3 Ducking Position

The **Position** control defines where ducking occurs in the signal path:

- **Pre** – Ducking happens before saturation and tone shaping
- **Post** – Ducking happens after saturation and tone shaping

Pre-position ducking sounds cleaner and more transparent.
Post-position ducking preserves harmonic density while controlling level.

5.4 Musical Use Cases

- **Vocals**
  Duck the reverb so the vocal stays forward while the space blooms naturally between phrases.
- **Delay Throws**
  Duck the delay so repeats stay clear without overwhelming the dry signal.
- **Ambient Pads & Effects**
  Use gentler ratios to maintain motion while preventing buildup.
- **Insert vs Send**
  Works equally well on inserts or return tracks, depending on routing and MixType.

5.5 Practical Notes

- Ducking responds to the **input signal**, not the wet signal.
- Ducking operates independently of MixType and routing mode.
- Extreme ratios combined with short release times can create rhythmic pumping effects.

The Ducking System is designed to help effects support the performance, not compete with it.

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6. Advanced Routing & Blend

Routing determines how the Plate and BBD interact and how the final effect integrates into a mix. While the architecture defines what is possible, this section explains how engineers typically use each mode in real-world sessions.

6.1 Series Mode

Series mode creates a single processing chain where one module feeds the next. This is ideal for **insert use**, where the effect is meant to transform the source.

6.1.1 Reverb → Delay

Use this when the Plate is the primary character and the Delay acts as a texture. This routing is effective for:

- EMT 140 vocal plates
- Lexicon 224 plates with motion or halo
- Snare plates needing soft diffusion at the edges
- Chorus-like stereo widening without obvious delay repeats

Musical behavior: Delay softens and smears the plate tail. Motion feels “around” the reverb, not in front of it. Works well for vintage and classic mix styles.

6.1.2 Delay → Reverb

Use this when you want rhythmic information or slap to define the space. This routing is effective for:

- Johnny Cash slap + plate
- U2 / The Edge delay into ambience
- Pre-delay that is more shaped than time-based
- Modern inserts where the delay creates the sense of depth

Musical behavior: Delay controls timing before the plate blooms. Plate smooths the repeats into a coherent field. Works well for contemporary vocals and guitars.

Series mode is the preferred choice when building a tone that should feel integrated with the source.

6.2 Parallel Mode

Parallel mode treats Dry, Plate, and BBD as independent branches. This is ideal for **send/return use**, where the goal is to layer space around the dry signal instead of altering it.

Parallel is effective for:

- Dub throws
- Wide stereo modulation
- Delay that must sit behind the dry vocal without changing its tone
- Reverb-only sends (Plate at 100 percent wet)
- Modern ambience where width and clarity matter

Musical behavior: Dry retains full integrity. Plate and Delay mix like console aux returns. Phase-coherent blending via Mix Type preserves the stereo image. Parallel mode shines when the effect should feel “around” the track rather than part of it.

6.3 Choosing the Right Mode

A simple selection guide:

- Choose **Series** when the effect is part of the instrument's tone (insert reverb, plate coloration, modulation on synths, flanger/chorus inserts).
- Choose **Parallel** when the effect is part of the mix environment (vocal reverb send, dub delay throws, ambience layers, subtle stereo motion).

6.4 How Module Bypass Behaves in Each Mode

- **In Series:** Bypassing BBD sends dry signal directly into the Plate. Bypassing Plate sends the delayed signal to the output. The overall tone changes because the modules feed each other.
- **In Parallel:** Bypassing a module simply removes its contribution to the wet mix. The dry signal remains untouched. Perfect for A/B comparisons without tonal shifts.

6.5 When Series Can Behave Like Parallel

If Plate and Delay are both set to 100 percent wet, and MixType is controlling final output balance, Series mode can act very close to Parallel—but still retains internal interaction. This is useful for certain wide chorus or no-phase-cancellation flanger presets.

7. Output, Gain Staging & Saturation

The Output Stage is the final processing domain in P930, completing the signal path with transformer-like coloration, level control, and master wet/dry mixing. It is designed to preserve headroom, maintain clarity, and provide the familiar glue associated with high-end analog equipment.

7.1 Gain Structure Overview

P930 contains several gain points, each with different musical implications.

- **Plate Input:** Level-sensitive; increasing input excites the virtual metal sheet, producing brightness and subtle ripple behavior. Lower input yields smoother, warmer results.
- **BBD Input:** Controls how hard the delay line is driven. Higher levels create more analog-like saturation and resonance buildup.
- **Output Stage:** Controls the loudness of the wet signal after all processing.
- **M. Out (Master Output):** The final gain for the entire plugin, applied after MixType blending. Used to match the processed level to the dry reference or surrounding mix. Each gain stage has a specific role, and they do not duplicate one another.

7.2 Output Saturation (P42 Engine)

The Output Stage uses a P42-style saturation module. This saturation is applied only to the **wet** signal, leaving the dry path untouched.

Musical benefits include:

- smoothing high-frequency buildup
- adding transformer-like density
- preventing weak tails from disappearing in busy mixes
- adding low-end cohesion without mud

Because the saturation is post-Plate and post-BBD, it gives the entire effect a unified, analog finish.

7.3 Balancing Mix Type and Output Gain

MixType influences perceived loudness. Certain curves give more psychoacoustic lift, requiring different output trims.

- **Sin3dB** usually needs little or no compensation.

- **Sin4.5dB** often requires +2 to +3 dB on M. Out.
- **Balanced** may require downward adjustment on inserts.
- **Linear** is neutral but can sound softer, depending on cancellation patterns. Preset designers should check the wet vs dry balance after selecting the MixType to avoid unintentionally boosting or attenuating the whole effect.

7.4 Master Output (M. Out)

This is the final loudness trim and should be used for: matching processed and raw levels, preventing peaks from clipping when using saturation, adjusting psychoacoustic differences created by MixType.

Because M. Out is post-saturation, it does not affect harmonic generation.

7.5 Output Stage in Insert vs Send Use

- **Insert Use:** M. Out should be set to maintain consistent track level. Mix controls determine how much of the effect replaces dry signal.
- **Send/Return Use:** Plate and Delay are set to 100 percent wet. Parallel mode is recommended. M. Out becomes the “return level” determining how much of the effect enters the mix bus.
- **Hybrid Use:** Sometimes Plate or BBD is used partially wet in Series mode. In this case, M. Out corrects any loudness mismatch introduced by the MixType curve.

7.6 Best Practices for Gain and Saturation

- Avoid pushing Plate Input too hard unless intentionally adding brightness or ripple character.
- Use BBD saturation sparingly for slapback, generously for analog motion.
- Keep Output saturation subtle on vocals, stronger for drums, guitars, and synths.
- Always check M. Out after choosing MixType.
- For mastering or stem-bus use, keep saturation low and control gain carefully.

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8. Noise, Modern/Vintage Behavior, and Extended BBD Modes

P930's BBD engine includes several behaviors that go beyond traditional analog hardware. This section explains how noise, bandwidth, and mode selection interact, and how preset designers can use them to achieve both authentic and expanded results.

8.1 BBD Noise Model

The BBD noise system is based on the statistical behavior of analog delay lines. It introduces low-level hiss with a soft spectral tilt, similar to aging bucket-brigade ICs.

How Noise Works in P930:

- Noise is added only to the **BBD wet path**, not to the dry.
- The noise level is scaled by **BBD input level**, **regen**, and **Mix**.
- When Mix is low (insert use), noise becomes almost inaudible.
- When Mix is high or regen is active, noise behaves more like vintage hardware.

When to Use Noise: Use noise **sparingly** unless emulating:

- tape slapback from early Elvis records
- Boss DM-2 or Memory Man character
- noisy 80s pre-delay into Lexicon or EMT plates
- gritty flanger and chorus vintage textures For modern slapback, modern choruses, cinematic delays, or pristine diffusion, noise should be at minimum or entirely off.

8.2 Clock Rate and the Modern/Vintage Switch

Clock Rate controls delay time and spectral bandwidth. In hardware, slower clock speeds drastically reduce bandwidth, producing a darker, murkier tone. P930 offers two behaviors:

8.2.1 Vintage Mode

- Bandwidth collapses as the clock slows.
- High frequencies roll off quickly.
- Modulation becomes thicker and blurrier.

- Noise becomes more apparent.
- Regen amplifies analog imperfections.

Use Vintage Mode for: retro slapback, Memory Man–style chorusing, flanger feedback sweeps, early house/techno short delays, character pre-delay before plates.

8.2.2 Modern Mode

Modern mode removes the hardware restrictions.

- Bandwidth stays extended regardless of clock rate.
- High frequencies remain open and bright.
- Noise is reduced in perception.
- Regen remains stable even at long delay times.

Modern Mode benefits: clean digital-style ping-pong, wide stereo chorus, long ambient delays, pre-delay for bright plates (Lexicon 224 style), precise rhythmic repeats. Modern Mode allows P930 to cover territory far beyond what a real BBD can do.

8.3 Extended BBD Ranges (beyond hardware)

In hardware, BBD delay time tops out early and goes unusably dark. P930 extends the usable range so long delays can still sound musical.

What This Enables:

- 450 ms to 750 ms BBD delays with clarity
- slow modulation rates without collapsing the top end
- stereo ping-pong patterns
- integrating BBD as a rhythmic element rather than a texture
- long pre-delay into plates without resorting to digital delays

Extended range is especially useful for ambient guitars, synths, cinematic scoring, and U2/Edge-style rhythmic delay stacks.

8.4 Interaction with Diffusion and Plate

When using BBD before or after the Plate:

- **BBD → Plate:**
    - Noise becomes part of the reverb texture.
    - Vintage Mode darkens the plate in a flattering way.
    - Modern Mode keeps the plate bright but controlled.
    - Regen can create metallic “pre-echo shimmer”.
- **Plate → BBD:**
    - Plate tail maintains integrity.
    - BBD coloration adds motion or smear.
    - Vintage Mode softens high-frequency plate tails.
    - Modern Mode enhances width and stereo motion.

This routing determines whether the BBD is a coloration tool or a spatial extension.

8.5 Practical Recommendations

- **For Authentic 60s/70s Delay:** Vintage Mode, Noise at −40 dB to −50 dB, Clock Rate 40–120 ms, Regen low, HPF slightly raised.
- **For Modern Slapback:** Modern Mode, Noise off, Clock Rate 90–150 ms, Minimal regen, LPF ≈ 8–12 kHz.
- **For Chorus/Flanger:** Vintage Mode for thick/soft, Modern Mode for bright/wide. Noise off unless intentionally gritty.
- **For Pre-Delay into Plates:** Modern Mode for EMT-style shine, Vintage Mode for earlier Capitol-style warmth. Noise off.
- **For Ambient and Cinematic:** Modern Mode, Long Clock Rate, Low noise, Moderate regen to build atmosphere.

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9. Practical Mix Workflows

P930 Lunar Lander is designed to adapt to different mixing roles, from subtle enhancement to creative sound design. This section outlines common, real-world workflows and how to approach them efficiently.

9.1 Insert vs Send Usage

As an Insert

- Use when the effect is part of the sound itself
- Common for guitars, synths, modulation effects, slap delays
- MixType and Main Out become critical for level matching
- Balanced or Sin-based MixTypes are often preferred

As a Send / Return

- Use for shared spaces and depth
- Set Plate and/or Delay to 100% wet
- Series routing is recommended for classic plate workflows
- Sin3dB is commonly used for neutral summing

9.2 Classic Studio Plate Workflow

A traditional studio approach inspired by EMT-style usage:

- Reverb first, Delay second (Series mode)
- Short to medium decay
- Moderate plate input for warmth
- Optional slap or pre-delay for separation

This creates a cohesive space that sits naturally behind the source.

9.3 Modern Spatial Design

For contemporary productions:

- Use Parallel routing for independent control
- Wider bandwidth and lighter damping
- Modulated BBD for motion and width
- Sin4.5dB or Balanced MixType depending on density

Ideal for vocals, pads, and cinematic textures.

9.4 Gain Staging and Level Matching

Lunar Lander separates wet-path level control from final output:

- **Plate Input / BBD Input** shape tone and excitation
- **Plate / BBD Output** adjust wet signal level
- **Main Out** compensates for perceived loudness changes

Different MixTypes require different gain compensation. This is normal and expected.

9.5 Using Ducking Musically

Ducking is most effective when subtle:

- Light ratios preserve ambience
- Faster releases feel natural on vocals
- Ducking reverb rather than delay often yields cleaner mixes

Extreme settings can be used creatively for rhythmic pumping effects.

9.6 Choosing the Right Toolset

Lunar Lander can function as:

- A classic plate reverb
- An analog-style delay
- A modulation processor
- A hybrid spatial design instrument

Do not think in terms of presets alone. Think in terms of **role in the mix**.

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10. Modulation Systems

P930 includes a lightweight modulation engine used to recreate the micro-movement found in plates, BBD delays, and early digital hardware. Modulation is not a chorus effect unless you intentionally drive it into that range. Its primary purpose is to avoid static, metallic tones and to introduce natural motion.

10.1 Plate Modulation

The Plate engine uses an internal modulation structure to prevent "ringy," phase-locked resonances that occur when diffusion is static. These controls are exposed:

- **Diff One / Diff Two:** Adjust the spread and complexity of the early diffusion clusters. Lower values make the plate tighter and more percussive. Higher values increase dispersion and reduce metallic ringing.
- **Bandwidth:** Controls how much the plate's resonant structure tightens. Lower bandwidth = warmer, softer, fewer high-frequency resonances. Higher bandwidth = brighter, denser, more lively.
- **Damping:** Controls how fast high frequencies decay relative to lows. Essential for balancing brightness against harshness. Important when pushing Input Drive into plate saturation.

Modulation in the plate is subtle and always tied to the internal model. It is not time-based and does not produce a sweep like a chorus unit.

10.2 BBD Modulation

The BBD section includes a **true delay-line modulator**, which behaves like a small chorus/vibrato engine when the module is active.

- **Rate:** Sets modulation speed (Hz). Slow rates (0.05–0.2 Hz) give gentle tape-like wandering. Medium rates (0.3–1.0 Hz) give noticeable movement. High rates lean toward vibrato or special effects.
- **Depth:** Sets modulation excursion, altering how far the delay time swings. Small depth maintains timing integrity. Medium depth creates classic analog movement. Large depth produces audible chorusing or flanging.
- **Offset Left / Right:** Stereo phase offsets for the modulation cycle. Small offsets widen the effect. Opposite offsets (e.g., L = 0.1, R = 0.9) produce strong stereo spread. Zero offsets keep the modulation mono.
- **Phase Flip:** Inverts one channel for a specific stereo character. Useful for Dimension-style widening or cancellation-based coloration.

When BBD **Mix = 0 percent**, the modulation still runs but the output remains dry. This allows you to use the modulator as a “movement generator” when the delay contribution needs to be minimal.

10.3 Interaction With Sync / Free Mode

Modulation always works in **Free Mode**. When Sync is enabled, only the **core delay timing** locks to BPM. The modulator does not sync; this is intentional and matches analog BBD behavior. This allows subtle timing drift even on tempo-locked presets, adding realism.

10.4 Modulation Guidelines by Application

- **Vocal Plates:** Plate-only modulation via diffusion settings. No BBD modulation unless intentionally adding motion. Recommended: BBD Mod Rate = 0, Mix = 0.
- **Slapback & Rockabilly:** No modulation, unless adding light tape wobble. Rate: 0.05–0.15 Hz, Depth: minimal.
- **Chorus and Flanger Presets:** Modulation becomes a primary effect. Chorus: Rate 0.2–0.8 Hz, Depth moderate, Offsets active. Flanger: Rate 0.1–0.4 Hz, Depth high, Regen engaged. TZF: depth and regen become critical.
- **Surface Movement on Pads:** Low-rate drift creates spatial instability. Rate: 0.05–0.15 Hz, Depth: small, Offset: small L/R difference.

10.5 Practical Notes

- Modulation is most audible when BBD Delay Mix is above 20 percent.
- Modulation interacts with MixType; different blend laws change the perceived depth.
- Delay modulation can smear transients if depth is too high.
- Plate diffusion modulation should be treated as tonal shaping, not time modulation.

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11. Bandwidth & Filtering

P930 provides independent tonal–shaping controls for both the Plate and BBD engines. These filters are not simply corrective EQ. They define how each engine behaves, how harmonics accumulate, and how the tail evolves over time. Understanding them is key to shaping believable plates, tight delays, and hybrid ambience.

11.1 Plate Filters

Each plate model includes a **High-Pass Filter (HPF)**, **Low-Pass Filter (LPF)**, and a **Bandwidth** parameter that determines how energy moves inside the simulated metal sheet.

11.1.1 High-Pass Filter (HPF)

Controls how much low-frequency energy enters the plate.

- Higher HPF values lighten the tail and reduce mud.
- Lower HPF values introduce body, bloom, and weight.**Recommended ranges:** Vocals: 120–180 Hz, Guitars: 150–200 Hz, Drums: 200–300 Hz for more focus.

11.1.2 Low-Pass Filter (LPF)

Sets the upper frequency limit of the plate.

- Lower LPF = darker, vintage tone.
- Higher LPF = bright, modern extension.**Recommended ranges:** Vintage EMT: 3500–4500 Hz, Lexicon-style plates: 6000–9000 Hz, Modern airy plates: 10 kHz and above.

11.1.3 Bandwidth (Q Envelope Control)

Defines how tightly the resonant structure is focused. This is not an EQ bandwidth; it controls how the energy disperses across plate modes.

- **Narrow bandwidth (lower values)** produces a darker, smoother, cohesive tail.
- **Wider bandwidth (higher values)** yields brighter, more lively behavior. In P930, the internal scale ranges from 0 to 10.**Practical ranges:** EMT 140 emulation: 2–4, Lexicon 224 plate: 0–2, Modern bright plates: 5–7.

11.2 BBD Filters

Although the BBD engine is a delay, not a reverb, its filters strongly affect tone and mix placement.

11.2.1 BBD High-Pass Filter

Scrubs low-frequency buildup. Useful for keeping delay taps out of the low-mid region. Essential when stacking repeats with Regen.**Recommended:** 40–120 Hz for most sources, Higher for guitars (120–180 Hz).

11.2.2 BBD Low-Pass Filter

Controls the softness of repeats. This mimics analog bucket-brigade rolloff.

- Lower values = darker, analog warmth.
- Higher values = more presence, but less vintage character.**Recommended:** U2 / The Edge style: 3000–6000 Hz, Clean digital-leaning slapbacks: 8000–12000 Hz.

11.3 Input Drive as a Tonal Filter

Although not a filter in the traditional sense, **driving the Plate Input** changes spectrum in a way similar to dynamic EQ:

- **Higher plate input** excites the virtual metal sheet. This produces: Brighter attack, More high-frequency ringing, Extended decay and ripple artifacts.
- **When input is reduced:** The plate warms, High-frequency chatter disappears, Tails become smoother and darker. This behavior emerged during preset development and is essential for realism. Classic engineers rode plate input, not EQ, to tune tone.

11.4 Output Filters (Post-Processing)

The Output Module includes **Input Saturation** and **Output Gain**, both operating on the wet signal only. Because saturation naturally compresses and rolls high frequencies, it can function as an implicit low-pass and harmonic enhancer.**Practical uses:** Add 0.1–0.5 percent saturation for glue on vocals, Push to 1–2 percent for warmth on guitars. Avoid saturation on precise ambience or orchestral reverb unless intentional.

11.5 How Filters Interact in Real Use

- **Voice Example:** HPF at 150 Hz clears mud, LPF at 3500–4500 Hz sets a vintage tone, Bandwidth 2–3 tightens the body, Input Drive low for smoothness.
- **Snare Plate:** HPF 200–300 Hz, LPF 5000–7000 Hz, Bandwidth 5 for brightness, Input Drive medium to excite the plate.
- **Ambient Guitar Delay:** BBD LPF 3–6 kHz, BBD HPF 60–120 Hz, Slight saturation for harmonic focus. These filtering choices determine whether a tail feels “inside the mix” or “floating above it.”

12. Saturation Architecture

P930 includes a **three-stage harmonic system** derived from the P42 engine. Saturation is not a global effect. Each processing block generates and responds to harmonics independently, which is essential for shaping warmth, perceived loudness, and how the Plate and BBD sit inside a mix. Rather than behaving like a simple analog "color" knob, each saturator influences dynamics, tone, and tail structure in ways unique to its location in the signal path.

12.1 Plate Saturation

The Plate module includes its own dedicated saturator. This is not meant as a distortion effect. It is modeled to replicate how a physical plate responds when excited with higher energy.

- **Practical behavior:** Low values (0.10–0.30) add glue and smoothness to the tail. Moderate values (0.30–0.60) increase brightness, lengthen decay buildup, and enhance metal excitation. High values (0.60–1.00+) can push the plate into a harder, shimmering zone, useful for pop vocals but not always appropriate for vintage tones.

- **When to use it:** To give space presence without using EQ, To increase articulation in the early reflections, To match the "lift" heard in driven EMT 140 plates, To raise the harmonic density when a plate must sit above guitars or synths.

12.2 BBD Saturation

The BBD engine includes its own saturation stage as well. Bucket-brigade delays naturally soften transients and roll high frequencies, so this saturator is designed to reinforce the analog feeling without introducing grit.

- **Practical behavior:** Low values warm up repeats without obvious saturation. Medium values introduce subtle harmonic bloom on taps. High values intentionally create character for vintage chorus and flanger tones.

- **When to use it:** To mimic driven analog delay pedals, To thicken slapbacks without raising feedback, To match Edge-style delays with a mild harmonic halo, For phaser and flanger presets where harmonic enhancement helps motion translate in a dense mix. Because BBD saturation precedes the Plate in Dly→Rev routing, it affects how the plate reacts. This is one of the subtleties that makes Lunar Lander capable of hardware-like synergy.

12.3 Output Saturation

The Output Module saturation affects **wet signal only**, not dry. This is essential for controlling presence and tone without changing the dry source.

- **Practical behavior:** Low values (0.01–0.20) act like transformer rounding. Medium values (0.20–0.40) add weight and forwardness. Higher values (0.40–0.80) create warmth and thickness in reverbs and delays, especially in drum rooms or guitar ambience. Very high values can act as mild compression on peaks. The Output Saturator is often the final tonal decision in a preset. A small change can rebalance the entire space.

12.4 Interaction Between the Three Saturators

One of the defining features of P930 is that these three saturators **compound**, creating dynamic behavior not found in typical reverb or delay plugins.

- **Key interactions:** BBD saturation feeding the plate increases tonal complexity and enhances stereo perception. Plate saturation feeding the output saturator changes decay texture, making tails feel more controlled. Low plate input + high output saturation recreates warm, early digital reverb tone. High plate input + low output saturation recreates bright, lively EMT tone. Small moves matter. Adjusting one saturator by 0.05 percent can subtly shift the depth and width of the space.

12.5 Guidelines by Use Case

- **Vocals:** Plate Sat: 0.20–0.40, BBD Sat: Off or very low, Output Sat: 0.10–0.30. Result: smooth, warm, intelligible.
- **Electric guitars:** Plate Sat: 0.40–0.70, BBD Sat: 0.10–0.30, Output Sat: 0.20–0.40. Result: presence and midrange lift without harshness.
- **Drum rooms:** Plate Sat: 0.50–0.90, BBD Sat: Off unless doing slap or flange, Output Sat: 0.30–0.60. Result: depth, weight, harmonic glue.
- **Synth pads / ambience:** Plate Sat: 0.10–0.30, BBD Sat: 0.20–0.50 (motion and color), Output Sat: 0.20–0.40. Result: lush, warm, harmonically rich.

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13. Noise, Modulation, and Nonlinearities

The character of P930 Lunar Lander is shaped not only by its plate and BBD engines, but also by the subtle nonlinearities that occur in real analog and electromechanical systems. These include **noise, frequency drift, phase offsets, micro-modulation, and excitation-dependent behavior**. Understanding these elements helps you shape presets that feel physical and musical rather than synthetic. This section explains how each nonlinear factor behaves, when it is desirable, and how to control it effectively.

13.1 BBD Noise

The BBD engine models authentic bucket-brigade noise, which increases as delay time increases. In real analog delays, this noise becomes part of the instrument, influencing tone, transient softness, and the sense of movement.

- **Behavior:** Noise becomes more audible at longer delay times. Noise has a broadband, slightly filtered texture. It interacts with modulation to create soft "motion haze". Turning noise fully off creates a more modern, hi-fi delay.

- **When to use noise:** Vintage flangers / choruses where BBD haze is essential, Guitar delays where realism and warmth matter, Wide modulation presets where noise masks phase movement, Sound design where texture is needed.

- **When to turn noise off:** Digital-clean 224-style presets, Tight slapback vocals, Modern time-based FX, Any preset where clarity is more important than authenticity.

13.2 BBD Modulation (Rate & Depth)

Even when the BBD Mix is low, Rate and Depth determine the "movement language" of the effect.

- **Behavior: Depth** determines the size of the pitch excursion. **Rate** determines how quickly it oscillates. **Offset L/R** creates stereo widening without ping-pong. Modulation influences the Plate when the routing is Dly→Rev.

- **Suggested ranges:** Chorus: Depth 3–7, Rate 0.20–0.60 Hz. Flanger: Depth 5–10, Rate 0.05–0.25 Hz. Slapback movement: Depth 1–3, Rate 0.10–0.20 Hz. Ambient motion: Depth 2–5, Rate 0.02–0.10 Hz (slow drift).

13.3 Phase Interplay

Phase characteristics influence width, tonal density, and perceived clarity. P930 includes: **Phase Flip** for stereo enhancement, **Offset L/R** to create asymmetry, **Diffusion parameters** in the Plate which alter the phase build-up of the reverb tail.

- **When to use phase flip:** To widen mono instruments, To reduce comb filtering in guitar delays, To add smoothness to vocal widening, To avoid flanging artifacts in stereo BBD setups.

- **When not to use it:** When mono compatibility is critical, On bass instruments, On sharply transient material where smearing is unwanted.

13.4 Plate Diffusion & Micro-Modulation

The Plate includes two controls that significantly impact tail texture: **Diff 1** (early diffusion density) and **Diff 2** (late diffusion spread). Both interact with **bandwidth** and **damping**.

- **Behavior:** Lower diffusion = more metallic, more "plate-like". Higher diffusion = smoother, more chamber-like. Very low diffusion + high input = metallic ripple and "sheet ringing". Subtle modulation inherently exists inside the plate engine.

- **Practical use:** Vintage Plate (EMT 140): Diff1 ≈ 50, Diff2 ≈ 45. Smooth Vocal Plate: Diff1 ≈ 70, Diff2 ≈ 60. Chamber Emulation: Diff1 80+, Diff2 80+. Experimental Metal Plate: Diff1 < 40, high input, high damping.

13.5 Nonlinear Plate Excitation (Input Level)

The Plate Input slider ranges from **–6 dB to +6 dB**, and throughout preset design we confirmed that this is one of the most influential controls in shaping the plate's tonal personality.

Behavior:

- **Higher input (0 to +6 dB)** excites the plate more, producing brighter tone, more metallic overtones, stronger transient reflections, increased ripple artifacts.

- **Lower input (–6 to 0 dB)** yields warmer decay, smoother tails, reduced harshness, more "vintage" character. This is not a simple gain stage. It alters how much energy enters the virtual metal plate.

Plate Type/Use Case	Input Range	Why
Warm Vocal Plate (Sinatra style)	–3 to –6 dB	Smooth, warm, no metallic ringing
60s / 70s EMT plates	–2 to –5 dB	Classic density without modern brightness
Modern Pop Plate	0 to +3 dB	Cleaner, brighter, more forward plate
Polished Bright Plate (SSL-era)	+2 to +4 dB	Controlled brightness, minimal harshness
Aggressive FX Plate	+4 to +6 dB	Strong excitation, intentionally metallic

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General rule: Stay within –6 to +6 dB, the true limits of the control. Avoid +6 dB unless specifically designing a hot, bright plate. Warm plates live in the negative range. Modern plates live around 0 to +3 dB.

13.6 How These Nonlinearities Combine

The magic of P930 often emerges when several of these behaviors overlap:

- BBD modulation feeding the Plate creates natural drift and stereo motion.
- Plate diffusion interacting with phase offsets increases perceived width.
- Plate input level into Plate saturation defines tail character.
- Noise + modulation adds realism to analog-style presets.
- Saturation at the output glues all nonlinearities into a cohesive sound.

These interactions create the “alive” quality of Lunar Lander and are the reason your presets evolved so naturally during development.

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14. Modulation Architecture

P930 Lunar Lander incorporates a selective modulation system designed to introduce motion, depth, and stereo interest without overwhelming the core reverb or delay tone. Modulation is available in the **BBD Delay module** and in limited internal forms within the **Plate** engine. This section outlines how modulation operates and how to use it musically.

14.1 BBD Delay Modulation

The BBD module includes **Rate**, **Depth**, and **Stereo Offset (L/R Offset)**. These parameters control time-domain modulation based on true analog BBD behavior.

14.1.1 Rate

Controls how fast the delay time is modulated.

- **Typical ranges:** 0.03 to 0.20 Hz for slow analog drift, 0.20 to 0.60 Hz for classic chorus-style widening, 0.60 to 2.00 Hz for vibey, vintage pitch fluctuation, 3+ Hz for flanger-style "motion" when Feedback is active.

14.1.2 Depth

Determines how far delay time is modulated.

- **Small depth (<1%)** creates subtle BBD instability.
- **Moderate depth (1%–4%)** produces chorus-like thickness.
- **Large depth (4%–10%)** generates pronounced detuning, flanging, and metallic sweeps. Depth remains musical even in extreme settings because the BBD engine internally compensates for pitch discontinuities.

14.1.3 Stereo Offset

Offsets the modulation phase between Left and Right channels for width.

- **0%** = mono modulation.
- **0.1 to 0.3** = natural stereo movement.
- **0.3 to 1.0** = wide, swirling stereo.
- **L negative / R positive combinations** produce dimensional asymmetry reminiscent of 80s rack choruses.

Recommended modulation combinations:

Intent	Rate	Depth	Offset	Notes
Tape drift	0.03 Hz	0.2%	0	Very subtle
Vintage Chorus	0.3 Hz	1–3%	0.2	Smooth widening
Dimension-D style	0.25 Hz	1–2%	0.5	Requires Balanced mix type
Flanger sweep	0.6–1.5 Hz	4–8%	0.3	Add feedback for dramatic sweeps
Experimental	3–5 Hz	6–10%	0.8	Metallic, rhythmic beats

Export to Sheets

14.2 Plate Reverb Micro-Modulation

The Plate section includes **internal micro-modulation** that simulates the natural instability of a steel plate. These controls are not directly exposed, but your **Damping**, **Diffusion 1/2**, and **Plate Size** settings determine modulation behavior.

How modulation emerges in the plate:

- **Higher diffusion** increases random early reflection "jitter".
- **Larger plate size** produces slower, more open movement.
- **Lower damping + high input** increases ripple modulation, similar to hardware EMT plates when hit hard. This modulation is subtle and primarily aims to avoid static "digital-plate" tone.

14.3 Interaction Between Delay Modulation and Plate Reverb

- When the signal path is **Dly → Rev**, BBD modulation affects only the source entering the plate, producing: chorused reverb tails, widening without smearing, classic Lexicon 224 modulated-plate feel, slow tape-like drift on the entire reverb space.
- When the signal path is **Rev → Dly**, modulation primarily affects the reverb tail, producing: fluttering decay, Lexicon PCM70-style "modulated rooms", spatial motion that feels like moving air.

The two behaviors are different and useful for specific tasks.

14.4 Modulation and Mix Type

Modulation interacts heavily with mix law:

- **Sin3 dB** preserves tonal balance when combining modulated delay with dry signal.
- **Balanced** yields stronger modulation presence and more pronounced width.
- **Sin4.5 dB or 6 dB** enhance chorus-like depth.
- **Linear** is most authentic for hardware-style flangers. Use mix laws intentionally to shape the perceived loudness and clarity of modulation.

14.5 Practical Use Cases

- **Vocals (Modern):** Rate 0.15 Hz, Depth 0.5%, Offset 0.2. Adds life without audible modulation.
- **Electric Guitar Chorus:** Rate 0.30–0.40 Hz, Depth 1–2%, Offset 0.3. Dimension-style widening without phase issues.
- **Psychedelic Flanger:** Rate 0.8–1.5 Hz, Depth 4–8%, with Regen. Classic jet-style swirl.
- **Stereo Movement for Pads:** Rate 0.2 Hz, Depth 1%, Offset 0.5. Provides motion without pitch wobble.

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15. Timebase, Sync, and Clocking Behavior

P930 Lunar Lander supports two timing paradigms for the **BBD Delay module**: **BPM-linked mode** and **millisecond free-run mode**. Understanding how the Clock Rate behaves in each mode is critical for predictable results, especially for slapback presets, modulation-based effects, and rhythmic echoes.

15.1 Clock Rate Overview

The **Clock Rate** slider represents the internal BBD clock that determines delay time and spectral bandwidth.

- Higher clock = shorter delay and wider bandwidth.
- Lower clock = longer delay and darker tone. It does **not** behave like a simple delay time knob. It behaves like real BBD hardware, where the delay time is derived from the clock and subdivision scaling.

15.2 Sync Mode (Linked to BPM)

When **Sync is ON**, two things happen:

1. **Clock Rate is no longer interpreted as milliseconds.** The clock is mapped to rhythmic subdivisions based on the DAW tempo.
2. **Time Sign (timesign_box) sets the subdivision.** Examples: 1 = quarter note, 2 = dotted eighth, 3 = eighth note triplet.

Because the internal BBD must maintain bandwidth integrity, the plugin performs compensation so that delay time tracks tempo while keeping the BBD tone intact.

What you can and cannot do in Sync mode

- You **cannot switch to ms**.
- You **cannot "dial in" ms values**.
- You **can only choose rhythmic divisions**.
- **Clock Rate slider** adjusts clock quality, not time. This is authentic to hardware. In sync mode, the user shapes the flavor of the delay, not the timing itself.

15.3 Millisecond Mode (Sync Off)

When **Sync is OFF**, the Clock Rate slider switches to true **millisecond mode**. This mode is essential for slapback, flanging, and non-tempo-based BBD effects.

Behavior

- The displayed value is **actual delay time in ms**.
- Modulation alters the time around the ms setting.
- Changing the Modern/Vintage mode affects bandwidth, not time.
- Feedback produces “analog” spiraling behavior.

Important detail discovered during testing When switching from BPM to MS, the **numerical position stays the same**, so the actual displayed delay time jumps. Example: In BPM mode the clock value might be 480 (not ms). When switching to ms, the same value is interpreted differently and may show 700 ms or more. This is expected because the same slider position maps to two different internal scales.

15.4 Modern vs Vintage and Their Influence on Timing

Modern/Vintage does **not** change the delay time. It changes: bandwidth, noise behavior, clock filtering, maximum usable feedback.

- **In Modern mode:** you can push the delay into bright and clear ranges, noise can be turned off entirely, flanger effects extend beyond traditional BBD limits.
- **In Vintage mode:** bandwidth is limited, noise becomes part of the character, long delay times become darker and softer.

15.5 Ping Pong and Clocking

Ping Pong uses the **same clock rate** but alternates channels according to the selected subdivision or ms value.

- **In Sync mode:** The bounce follows the rhythmic grid.
- **In MS mode:** The bounce happens at the true ms interval. Bandwidth, modulation, and saturation apply per-channel, so ping-pong can produce strong stereo contrast when combined with stereo offsets.

15.6 Practical Timing Use Cases

- **Slapback (Cash / Rockabilly / Americana):** Sync OFF, 90 to 140 ms (125 ms ideal starting point), No feedback, No modulation, Power ON, Mix 100%, Series routing for insert replacement, Parallel for send-style.
- **Tempo Echo (U2 / The Edge):** Sync ON, Dotted eighth or quarter subdivision, Feedback 10–20%, Mix depends on insert vs send, Mod Depth 1–3%, Rate 0.3–0.5 Hz.
- **Analog Flanger:** Sync OFF, 0.3 to 8 ms, Mod Depth 4–10%, Regen as needed, Phase Flip ON when applicable.
- **Ambient Delay + Plate:** Sync ON or OFF depending on needs, Long delays feed into Plate, Mod Depth low, Plate Mix 30–60% for atmospheric blends.

15.7 Summary

Mode	Timing Source	Editable?	Use Cases
Sync ON	DAW Tempo	Subdivisions only	Rhythmic delays, ping-pong, tempo-dependent effects
Sync OFF	Milliseconds	Fully editable	Slapback, flanger, chorus, sound design, vintage BBD behavior

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The key is choosing the correct mode based on whether your timing should be **musically fixed to tempo** or **free-running like hardware**.

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16. Plate Engine Behavior, Bandwidth, and Metal Excitation

The Plate section in P930 is not a generic digital reverb. It models the interacting behaviors of a real metal plate, including bandwidth shaping, excitation energy, diffusion topology, and micro-modulation. This section outlines how each control shapes tone and decay, and how parameters interact.

16.1 Plate Size

Plate Size selects the internal diffusion and modal density structure. Although presented as Size 0, 1, and 2 internally, these correspond to:

- **Plate 1 (short):** Tight, controlled, fast buildup, ideal for vocals and vintage plate tones.
- **Plate 2 (medium):** More spread, slightly slower development, smoother diffusion.
- **Plate 3 (large):** Largest modal density, open decay, more chamber-like bloom.

Practical guidelines

- For **classic EMT 140**, Plate 1 or Plate 2.
- For **modern pop plates**, Plate 2.
- For **ambient and orchestral**, Plate 3.

16.2 Bandwidth (Plate Bandwidth Slider)

Bandwidth determines how much of the plate's spectrum is allowed to resonate. This is a true **Q-tightening control**, not a high/low cut.

- **At 0:** Wide bandwidth, natural plate openness.
- **Higher values:** Tight bandwidth, fewer active resonances, more focused tone.

Use cases

- **0–2:** Natural, warm plates.
- **3–6:** Vocals needing resonance control.
- **7–10:** Special effects or darker constrained plates. This parameter directly interacts with HPF and LPF.

16.3 HPF and LPF (Plate Filters)

Both filters determine the boundaries of the frequency range feeding the plate.

- **HPF** reduces rumble, boom, and low clutter.
- **LPF** shapes the brightness and prevents metallic ringing.

Guidelines

- **Vocals:** HPF 100–180 Hz, LPF 3–6 kHz.
- **Guitars:** HPF 80–120 Hz, LPF 6–10 kHz.
- **Drums:** Use wider LPF for snare (8–10 kHz), tighter for overhead verbs.

16.4 Input Level (Metal Excitation Control)

This is one of the most important plate-shaping controls. Range: **–6 dB to +6 dB**.

Behavior

- **Negative values (–6 to –1 dB):** Warm, smooth, reduced ringing. Best for vintage warmth (Sinatra, Motown, 70s ballads).
- **0 to +3 dB:** Modern clarity, more high-frequency excitement.
- **+4 to +6 dB:** Metallic zing, ripple tail, shimmering reflections. Useful for special FX or modern pop sheen.

Rule of thumb If your plate is too bright or "splashy," **lower Input** before adjusting filters.

16.5 Damping

Controls how quickly high-frequency energy decays relative to low frequencies.

- **Higher Damping (5–10 kHz)** = crisp, fast-decaying highs.
- **Lower Damping (2–5 kHz)** = softer, longer high-frequency decay.

Interpretation Lower numbers do not mean "darker." They mean the decay **extends** further in high frequencies.

Guidelines

- **Warm vocal plate:** 3–4 kHz
- **Classic EMT:** 3.5–5 kHz
- **Modern pop:** 6–8 kHz
- **Bright FX:** 8–10 kHz

16.6 Diffusion 1 and Diffusion 2

These two parameters shape the internal scattering of early reflections.

- **Diffusion 1:** Controls how the energy initially spreads.
- **Diffusion 2:** Governs late diffusion and tail smoothness.

Behaviors

- **Higher Diffusion (60–85%):** Smooth, cohesive, modern plate. Less texture, more polish.
- **Lower Diffusion (15–45%):** Grainier, vintage, slightly gritty tail.

Recommended combinations

Intent	Diff1	Diff2
EMT 140 vintage	35–55	30–50
Modern vocal	60–75	50–65
FX tails	75–85	70–85

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16.7 Saturation (Plate Saturator)

This saturator colors **only the plate return**, not the dry signal.

- Adds harmonic glue.
- Helps plate sit in the mix without EQ.
- Thicker low-mid content at moderate values.
- Subtle at <0.3, more obvious above 0.5.

Guidelines

- **Vintage plate:** 0.0–0.3
- **Pop vocal:** 0.3–0.6
- **FX:** 0.5–1.0

16.8 Plate Predelay

Predelay establishes separation between dry source and early reflections.**Values by genre**

- **0–10 ms:** 60s/70s vocal plate
- **10–20 ms:** Modern vocal presence
- **20–40 ms:** Drums, guitars, pop clarity
- **40+ ms:** Sound design, distance effects Predelay is musically powerful because it controls articulation and perceived space.

16.9 How Parameters Interact (Important)

- **Interaction 1: Input Level & Damping** – High input with low damping = bright ringing. Low input with low damping = smooth but extended decay. High input with high damping = bright but controlled splash.
- **Interaction 2: Bandwidth & Filters** – Tight bandwidth + high HPF = thin but focused. Wide bandwidth + low LPF = soft and warm.
- **Interaction 3: Diffusion & Predelay** – Low diffusion + short predelay = gritty early reflections. High diffusion + long predelay = very polished sound.

16.10 Summary Cheat Sheet

Parameter	Controls	Typical Range for Vocals
Plate Size	Modal density & spread	1 or 2
Input	tonal brightness / warmth	–4 to –1 dB
Bandwidth	resonance tightness	2 to 6
Damping	HF decay	3–6 kHz
Diffusion 1	early reflection texture	40–65
Diffusion 2	tail smoothness	35–60
LPF	top-end	3–6 kHz
HPF	low trim	120–180 Hz
Predelay	articulation	5–20 ms
Saturation	harmonic color	0.15–0.40

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17. BBD Delay Architecture, Noise, and Feedback

The BBD module in P930 is a hybrid design that captures the musicality and richness of analog bucket-brigade delays while extending their range for modern workflows. This section explains how each control shapes the delay sound and how the module behaves in both traditional and extended modes.

17.1 Clock Rate (Core Timing Engine)

The **Clock Rate** determines the BBD's internal sampling frequency. This value directly impacts: Delay time, Bandwidth, Noise floor, Modulation response, Feedback tone.

Behavior summary

- **Higher clock** = shorter delay, brighter, cleaner.
- **Lower clock** = longer delay, darker, more analog smear. P930 respects this analog pattern even when operating outside historical BBD limits.

Practical ranges

- **Short delays (0–15 ms):** Flanging, through-zero flanger, doubler effects.
- **Medium delays (15–80 ms):** Chorus, widening, Haas effects.
- **Long delays (80–250 ms):** Slapback, rhythmic echo, tape-like spacing.
- **Extended delays (250+ ms):** Only possible in Modern mode; useful for atmospheric FX.

17.2 Noise (BBD Noise Slider + Noise Button)

Classic BBD circuits always introduced noise from clock bleed and transistor stages. P930 allows control over two aspects:

- **Noise Enabled (Button):** ON = authentic BBD noise. OFF = ultra-clean extended BBD, not possible in classic hardware.
- **Noise Amount (Slider):** Controls the loudness of the noise floor when enabled.

Use cases

- **Vintage chorus/flanger** → Noise ON at –50 to –35 dB
- **Authentic analog slapback** → Noise ON at –45 to –30 dB

- **Modern delay/FX** → Noise OFF for pristine tails
- **Lexicon-style modulated verbs** → Noise OFF for clarity

Noise interacts with **Feedback**; higher regen amplifies noise just like real BBD units.

17.3 Bandwidth

This slider tightens the usable spectral range of the BBD output.

- **Low values (0–2)** → Full bandwidth, classic BBD tone
- **Moderate values (3–6)** → Midrange-focused, vintage flavor
- **High values (7–10)** → Narrow, effect-like coloration for special FX Bandwidth also constrains modulation depth subtly by limiting HF excursion.

17.4 Feedback (Regen)

Feedback sends part of the output back into the input, creating repeats or cyclic sweeps.

Behavior

- **Low Regen (0–1):** Soft widening, Haas-style thickening.
- **Moderate Regen (1–3):** Classic delay repeats, light flanging.
- **High Regen (3–4.5):** Jet flanger sweeps, 70s/80s resonant movement.
- **Near maximum (>4.5):** Feedback buildup; excellent for sound design but unpredictable if Bandwidth is narrow.

Important: Feedback coloration is affected by Clock Rate, Bandwidth, Noise, Saturation, and Modulation Depth. This creates the evolving harmonic motion characteristic of analog BBDs.

17.5 High-Pass and Low-Pass Filters

These filters shape the tone before the BBD stages.

- **High-Pass:** Controls low-frequency content entering the delay. Useful for reducing mud and boom.
- **Low-Pass:** Controls high-frequency presence in delay repeats. Essential for shaping classic “tape-y” or “analog bucket” darkness.

Recommended settings

- **Vintage slapback:** LPF 1–6 kHz, HPF 80–180 Hz
- **Modern clean delay:** LPF 10–20 kHz, HPF off
- **Flanger/chorus:** LPF wide open, HPF moderate to avoid phase mud

17.6 Saturation

The BBD-specific saturator contributes: Soft asymmetry, Slight low-mid bloom, Gentle compression at higher levels, Tone glue, especially in rhythmic presets.**Ranges:** 0.0–0.3: Light coloration. 0.3–0.7: Rich analog tone. 0.7–1.0: Crunchy, effect-type saturation.

17.7 Stereo Offset (Offset L/R)

Stereo modulation phase separation.

- **0.0 / 0.0** → Mono
- **0.1–0.3** → Natural stereo movement
- **0.3–1.0** → Wide, motion-rich imaging
- **Asymmetric L/R** → Organic instability similar to vintage rack units Offset interacts strongly with the MixType law.

17.8 Modern vs Vintage Mode

These modes determine the BBD's core behavior.

17.8.1 Vintage Mode

- Bandwidth rolls off naturally
- Noise bleeding is active when enabled
- Delay time limited to BBD-realistic ranges
- Feedback becomes dirtier and thicker
- Modulation pitch warble increases

Ideal for: Slapback, Vintage choruses, Flangers, Echoes with attitude.

17.8.2 Modern Mode

- Higher bandwidth ceiling
- Noise can be completely disabled
- Delay times extended far beyond hardware
- Clearer feedback path
- Suitable for ambient and clean digital-style delays

Ideal for: U2 “Edge” style rhythmic delays, Clean widening, Reverb pre-delay extensions, FX design.

17.9 Ping-Pong Behavior

Ping-Pong alternates delay repeats between left and right channels.

- **Behavior in Sync Mode (BPM):** Repeats follow musical subdivisions, Left-right alternation is quantized, Stereo field feels rhythmic and structured.
- **Behavior in MS Mode (free-run):** Bounce timing reflects the exact ms delay, More analog-feeling, Great for slapback width without strict tempo locking.
- **Bandwidth & Ping-Pong:** Wide bandwidth → clear separation. Narrow bandwidth → warmer, more intimate bounces.

17.10 Practical BBD Recipes

- **Classic Slapback (Cash, Rockabilly):** MS mode, 110–140 ms, No modulation, Feedback minimal, HPF 80–120 Hz, LPF 3–6 kHz, Noise optional.
- **The Edge / U2 Rhythmic Delay:** Sync ON, Dotted eighth, Feedback 10–20%, Mod Rate 0.3–0.5 Hz, Depth 1–3%, Modern mode, Mix law: Balanced or Sin4.5 dB.
- **Vintage Analog Chorus:** 15–25 ms, Rate 0.2–0.4 Hz, Depth 1–2%, Offset 0.2–0.3, Noise ON, Vintage mode.
- **Jet Flanger:** 0.3–5 ms, Depth 4–10%, Regen 3–5, Offset 0.3, LPF open, Mix Type: Linear.

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18. Routing Summary

Setting	Series	Parallel
Best for plate-only	Yes	Not recommended
Delay → Reverb behavior	Authentic	None
Widest stereo width	Sometimes	Often
Noise shaping	Strong	Independent per module
Dry signal leakage	No	Possible if delay path has dry content

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19. MixType Blend Laws: Behavior, Tone, and Practical Use

P930 offers multiple **wet/dry mixing laws** that determine how the **perceived loudness, phase relationship, and tonal balance** behave when blending processed and unprocessed signal paths. These blend laws are fundamental to chorus, flanger, doubling, and even certain plate or delay presets. Each MixType affects: Perceived output level, Presence and depth, Stereo width, Phase interaction, How delay and reverb layers sum. This section defines each law and provides concrete musical use cases.

19.1 MixType Overview

MixType is selected via **MixType slider** (Mix Rules). Common values include: **Linear, Balanced, Sin3 dB, Sin4.5 dB, Sin6 dB, SR3 dB / SR4.5 dB** (if exposed). These represent different curves for combining Dry and Wet signals.

19.2 Linear

- **Behavior:** Pure mathematical linear crossfade. At 50 percent mix, both dry and wet are at –6 dB. Produces the strongest phase cancellation when modulated delay is around 0–15 ms. Most authentic for vintage flangers and TZF behavior.
- **Use Cases:** Analog flanger emulation (ADA, Boss BF-2, Electric Mistress), Through-zero flanging, Jet flanger wide, Vintage chorus with subtle movement.
- **Notes:** Usually requires **+5 to +6 dB** Master Output compensation. This is normal.

19.3 Balanced

- **Behavior:** Preserves perceived loudness when sliding between dry and wet. Voices the wet slightly louder at mid mixes. Gives delay and modulation effects extra presence. Less cancellation than Linear.
- **Use Cases:** U2 / The Edge rhythmic delays, Dimension-D style choruses, Wide stereo modulations, Insert delays where presence is needed.
- **Notes:** Often needs **1–2.5 dB** gain compensation.

19.4 Sin3 dB (Sine –3 dB)

- **Behavior:** Smooth, musical crossfade. Maintains strong dry presence while introducing modulation or reverb. Mild attenuation ensures plate or delay stays tucked in the mix.
- **Use Cases:** EMT140 plate presets, Lexicon 224 plate presets, Dub throw / Send presets, General-purpose reverb/delay inserts. This is the most "invisible" blend law, which is why it works for plates.
- **Notes:** Usually **no gain compensation needed**.

19.5 Sin4.5 dB (Sine –4.5 dB)

- **Behavior:** More wet-forward than Sin3 dB. Enhanced modulation depth. Good for modern chorus and flanger tones.
- **Use Cases:** Boss CE-1 / CE-2 style chorus, Wide stereo chorus for pads, Insert chorus where wet signal must dominate.
- **Notes:** Typically requires **+2 to +3.5 dB** Master Output.

19.6 Sin6 dB (Sine –6 dB)

- **Behavior:** Strongest wet emphasis among sine-based rules. Maximum depth perception in chorus. Very open stereo width.
- **Use Cases:** Modern lush chorus, Ambient widening, FX modulation where wet signal must dominate.
- **Notes:** Often needs **+3 to +4.5 dB** M.Out.

19.7 SR3 dB / SR4.5 dB (Soft-Round Mix Curves)

(If exposed in the version being used)

- **Behavior:** Softer crossfade compared to standard sine curves. Gentle dry retention with rounded transition. Tends to reduce comb filtering.
- **Use Cases:** Subtle chorus on vocals, Plate + delay blends, Solo instruments requiring transparency.

19.8 Choosing the Right MixType: Practical Chart

Effect Type	Recommended MixTypes	Why
Vintage Flanger (BF-2, Mistress)	Linear	Preserves authentic cancellation and jet sweep
TZF Flanger	Linear	Needed for through-zero null
Dimension-D / Studio Doublers	Balanced	Adds presence and stereo width
Classic Chorus (CE-1/CE-2)	Sin4.5 / Sin6	Enhances depth and lushness
Subtle Vocal Chorus	Sin3 / SR3	Minimal phase coloration
Slapback Delay Insert	Balanced	Keeps delay audible without level loss
U2 The Edge Delays	Balanced	Cut-through presence
Plate Reverbs (EMT, 224)	Sin3	Natural wet/dry relationship
Dub FX send presets	Sin3	Cleaner send behavior
Wideners	Sin4.5 / Balanced	Wide and controlled
Flanger Wide FX	Linear / Balanced	Depends on desired density
Ambient FX	Sin6	Maximum wash and stereo spread

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19.9 Real-World Observations from Preset Development

- **Sin3 dB** is ideal for the majority of plate and reverb presets.
- **Balanced** is ideal whenever delay must “speak” clearly in a mix (Edge delays).
- **Linear** is essential for hardware-authentic flanger and TZF behavior.
- **Sin4.5 / Sin6** give lush modern chorus depth when needed.
- **Master Output compensation is part of preset design**, not a mistake.
- Mix laws dramatically change perception even if the wet percentage is the same.

19.10 Summary

MixType	Tone	Strengths	Weaknesses
Linear	“Raw, phase-active”	Best for flanger	Needs the most gain
Balanced	“Clear, present”	Delay clarity	Slight over-brightness if overused
Sin3 dB	“Natural, smooth”	Plate and Lexicon presets	Least dramatic modulation
Sin4.5 dB	Wet-forward	Modern chorus	Needs gain compensation
Sin6 dB	Very wet	Ambient widening	Can wash out detail

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20. Noise, Artifacts, and When to Use Them

P930 provides several controllable artifacts that emulate the mechanical and electrical imperfections of real hardware. These include **BBD noise**, **plate excitation artifacts**, **phase-dependent ripple behavior**, and **feedback-driven harmonic buildup**. When used correctly, these artifacts add realism, depth, and musical texture. When misused, they can create unwanted harshness or clutter. This section explains how each artifact behaves and when to use it for maximum musical benefit.

20.1 BBD Noise

The BBD module offers both a **noise button** (ON/OFF) and a **noise amount slider**.

Behavior

- When ON, the noise follows real BBD principles: Noise increases as clock rate decreases, Feedback amplifies the noise, Tone is shaped by bandwidth, HPF, and LPF.
- When OFF, the BBD operates in a "clean extended" mode not possible in hardware.

When to Use BBD Noise Use noise **intentionally**, not by accident.

- **Recommended use cases:** Vintage slapback (Elvis, Johnny Cash) – A little noise adds authenticity; –50 dB to –35 dB range. Vintage chorus / flanger – Mutron, Boss BF-2, ADA, Mistress all rely on noise for character. Analog echo-style delays – Adds spatial glue and warmth.
- **Avoid noise when:** Designing modern clean delays, Using the delay as pre-delay for a plate (unless vintage tone is desired), Creating chorus/widener presets for pop or EDM, Building cinematic or ambient effects. Noise should be part of the **sound design intention**.

20.2 Plate Ripple and Metal Excitation

Ripple is a natural artifact of steel plates when excited by high transient energy. In P930 it is controlled mostly by the **Plate Input (±6 dB)** and the overall **diffusion/damping balance**.

How ripple behaves

- Higher Plate Input → more metallic zing, more HF shimmer
- Lower Damping → longer HF resonance
- Higher Diffusion 1/2 → smoother early reflections, ripple becomes subtle
- Tight Bandwidth → controlled but texture-heavy ripple Ripple is the reason plate reverbs feel "alive" and not sterile.

Use ripple when: Creating authentic EMT 140 tones, Adding presence to vocals, Designing bright 70s plates, Building percussive effects (snare plates).**Avoid ripple when:** Designing warm or dark plates, Building ambient pads, Creating smooth modulation plates, Building "Lexicon-style" plates, which need cleaner tails. Ripple is **not** a defect; it is a color choice.

20.3 Modulation Artifacts

- **In BBD mode:** Modulation increases pitch drift, Depth interacts with clock rate, Stereo offset introduces dual-phase motion. When delay time is small (<10 ms), modulation creates flanging nulls.

- **In Plate mode:** There is subtle micro-modulation tied to Size, Diffusion, and Damping. Plate movement becomes audible when excited strongly.

Use modulation artifacts when: Building chorus, flanger, or widener presets, Creating 80s Lexicon-inspired modulated reverbs, Adding subtle “vintage instability” to a vocal plate.**Avoid when:** Precise timing is required (slapback), Designing transparent or mastering-style reverbs.

20.4 Feedback Distortion and Self-Oscillation

At high regen values: Harmonics accumulate, Noise becomes part of the feedback loop, Bandwidth filtering creates dark repeating sweeps, Modulation becomes increasingly dramatic. This is a natural BBD effect and can be musically desirable.

- **Use cases:** Jet flanger, Dub feedback throws, Industrial sound design, Rising feedback textures.

- **Avoid for:** Clean rhythmic delays, Predelay into plate, Subtle stereo widening.

20.5 Phase-Dependent Artifacts (Polarity Switch)

The Polarity switch flips the BBD output phase before mixing. Polarity artifacts occur when: Delay time is very short, MixType is Linear or Balanced, Modulation depth is moderate or high.

- **These artifacts create:** Comb filtering, Enhanced stereo width, Through-zero cancellation, Hollow or “swishing” tones.

- **Use polarity intentionally in:** Flanger, TZF, Wide choruses, Slapback + reverb separation.

- **Avoid in:** Clean reverb presets, Lexicon-style ambience, Pure plate-only presets.

20.6 Artifact Checklist for Practical Workflows

Goal	Artifact to Use	Artifact to Avoid
Vintage slapback	“BBD noise, low clock”	“Modulation, polarity”
EMT vocal plate	“Ripple, mild saturation”	BBD noise
Lexicon 224 plate	“No ripple, no noise”	Harsh excitation
Flanger	“Modulation, polarity, feedback”	Sin3dB mix
Dimension-D chorus	“Balanced mix, slow offset”	Linear mix
Ambient reverbs	“Low ripple, wide bandwidth”	BBD noise
Rockabilly FX	“Noise, ripple, saturation”	Clean modern plate

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20.7 Summary

Artifacts in P930 are not accidents. They are **colors**. **Noise** adds realism. **Ripple** adds life. **Modulation** adds motion. **Feedback** adds energy. **Polarity** adds dimension. Knowing when to use each is what separates an average preset from a musical one.

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21. Practical Preset Design Methods

This section provides a clear, repeatable workflow for designing P930 presets for vocals, guitars, drums, and special effects. Each method focuses on **how engineers actually build presets**: choosing the plate model, shaping tone, selecting the correct MixType, and refining motion or space. The goal is **speed + repeatability**, without artistic compromise.

21.1 Vocal Plate Design

Vocal plates depend on clarity, warmth, and controlled brightness. The Plate Input, HPF/LPF, and Damping are the dominant tools here.

Step-by-step method

1. **Start with Plate Size**
    - **Plate 1** for vintage tones
    - **Plate 2** for modern
    - **Plate 3** for airy ambience
2. **Set Plate Input**
    - **–3 to –6 dB** for warm vintage plates
    - **–1 to +1 dB** for modern
    - **+3 to +6 dB** only when intentionally bright
3. **Shape the tone**
    - **HPF** = 120–180 Hz
    - **LPF** = 3–6 kHz
    - **Bandwidth** = 2–6 depending on desired tightness
4. **Set the decay**
    - **1.3–2.5 seconds** for vocals
    - **Longer** only for ballads or ambient vocals
5. **Diffusion settings**
    - **Diff1:** 40–65

- **Diff2:** 35–60 Lower values emulate EMT plates; higher values give Lexicon smoothness.

6. **Predelay**
    - **5–20 ms** for articulation
    - **0–5 ms** for vintage glue
7. **Saturation**
    - **0.1–0.3** is enough to sit vocals “inside” the plate
8. **MixType**
    - Vocal plates = **Sin3 dB**

21.2 Vocal Slapback + Plate

This follows the **Johnny Cash / classic country** method.

Slapback Steps

1. Delay in **ms mode**
2. Time = **110–140 ms** (125 ms sweet spot)
3. Feedback = 0
4. Modulation OFF
5. HPF 80–140 Hz
6. LPF 3–6 kHz
7. Saturation mild
8. Noise ON if vintage

Into Plate

1. Routing = **Series**
2. Plate Size = 1 (vintage)
3. Plate Input = –2 to –4 dB
4. Decay = 1.4–2.0 seconds

5. Predelay = 0–12 ms

MixType

- Insert version: **Balanced**
- FX send version: **Sin3 dB**

21.3 Modern Vocals (Pop, R&B, EDM)

Steps

1. Plate Size = 2
2. Plate Input = 0 to +3 dB
3. Decay = 1.8–2.8 s
4. Damping = 5–8 kHz
5. LPF = 5–8 kHz
6. Diffusion 1/2 = 60/50
7. Predelay = 10–25 ms
8. Add **modulation in the BBD** (0.2–0.4 Hz, 1–2 percent) feeding the plate.

MixType

- **Sin3 dB** or **Sin4.5 dB** depending on brightness

21.4 Guitar: Clean, Ambient, and Edge Style Delays

21.4.1 Clean Guitar Plate

- **Plate Size:** 1 or 2
- **Decay:** 1.2–2.0 s
- **Damping:** 3–6 kHz
- **Plate Input:** –1 to –3 dB
- **Predelay:** 10–20 ms
- **MixType:** Sin3 dB

21.4.2 U2 / The Edge Rhythmic Delay

- **Sync:** ON
- **Subdivision:** dotted eighth or 1/4
- **Feedback:** 10–25 percent
- **HPF:** moderate (120–200 Hz)
- **LPF:** around 6–10 kHz
- **Saturation:** 0.2–0.5
- **Mod Depth:** 1–3 percent
- **Routing:** Series if plate is used
- **MixType:** Edge delays = **Balanced**

21.5 Electric Guitar Flanger

Steps

1. Delay = 0.3–8 ms
2. Modulation: Rate = 0.3–1.0 Hz, Depth = 4–10 percent
3. Regen = 2–4.5
4. Offset L/R = 0.2–0.4
5. Polarity = ON (most flangers)
6. LPF wide open

MixType

- **Linear** for authentic ADA, BF-2, Mistress (Then raise Master Out by +5 to +6 dB)

21.6 Chorus Presets

Classic CE-1 / CE-2 style

1. Delay = 10–25 ms
2. Rate = 0.25–0.45 Hz

3. Depth = 1–3 percent
4. Offset = 0.2
5. Polarity OFF
6. Noise optional (OFF for modern)
7. MixType: **Sin4.5 dB** or **Sin6 dB**

21.7 Drums: Plates and Rooms

Snare Plate

1. Plate Size = 1
2. Plate Input = 0 to +3 dB
3. HPF = 150–250 Hz
4. LPF = 5–8 kHz
5. Diff1 = 50–70
6. Diff2 = 30–50
7. Decay = 1.0–1.6 seconds
8. Predelay = 0–10 ms

Drum Bus Ambience

1. Plate Size = 3
2. Decay = 0.5–1.5 s
3. Damping = 5–7 kHz
4. Plate Input = –2 to +1 dB
5. Use in Parallel

MixType

- Plates = **Sin3 dB**
- Ambience = **Sin3** or **Balanced**

21.8 Synth Pads and Ambient FX

Steps

1. Plate Size = 3
2. Bandwidth = 0–2
3. Decay = 3–7 seconds
4. Plate Input = –2 to +2 dB
5. Add chorus via BBD: Rate 0.2 Hz, Depth 1–2 percent, Offset 0.5
6. Routing = Series
7. MixType = **Sin6 dB** for spaciousness

21.9 Dub, Throw, and Creative FX

Dub Throw Delay

1. Sync ON
2. Quarter or eighth notes
3. Feedback 30–80 percent
4. Saturation 0.5–1.0
5. Noise ON for vintage dub
6. Parallel mode
7. MixType = **Sin3 dB**

Time-Shifting FX

1. Use ms mode
2. Set delay 300–600 ms
3. Add modulation 0.4–1.0 Hz
4. Tight bandwidth for “radio” FX
5. Saturate heavily

Reverse Bloom Plate

1. Decay short (1–2 s)
2. Predelay large (30–70 ms)
3. Strong diffusion balance
4. Plate Size = 1
5. MixType = **Sin6 dB**

21.10 Output Gain and MixType Compensation

Once the preset sounds right, adjust:

- **Wet Saturator** for tone
- **Master Output** to normalize loudness

Typical boosts required:

- **Linear:** +5 to +6 dB
- **Balanced:** +1 to +2.5 dB
- **Sin4.5/Sin6:** +2 to +4 dB

21.11 Summary

Preset design in P930 is built around four key decisions:

1. Choose the plate size and input level (tone).
2. Set delay time appropriately (timing or modulation).
3. Shape bandwidth and damping (color).
4. Choose the correct MixType (blend and loudness). With these foundations, every preset becomes predictable and musically intentional.

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22. Tips, Troubleshooting, and Advanced Best Practices

This section distills practical guidance gathered during real-world preset development, covering tonal behavior, module interaction, gain staging, and common pitfalls.

22.1 Understanding Plate Input Behavior

The Plate Input slider is one of the most influential parameters in P930.

Warm / Smooth (Lower Input)

- Set Plate Input to **–2 to –6 dB**
- **Result:** Softer transients, Less excitation of the virtual plate, Reduced brightness, No metallic “ripple” tail

Bright / Driven (Higher Input)

- Plate Input **0 to +6 dB** excites the digital plate structure.
- **Result:** More upper harmonic movement, Vintage EMT “shimmer”, Possible natural “rippling” in the tail at extreme levels

This is **not EQ**; it is mechanical simulation behavior.

22.2 Why Bandwidth Matters in Both Plate and BBD

The Bandwidth sliders narrow or widen the effective frequency range feeding the internal scattering network.

Wide Bandwidth (0–2)

- Open, natural
- Suitable for Lexicon-style smooth plates
- Ideal for vocal clarity

Narrow Bandwidth (6–10)

- Tight, resonant
- Useful for vintage EMT coloration
- Good for drums and FX

Note:

- **Plate Bandwidth ranges 0–10**
- **BBD Bandwidth ranges 0–10** but behaves differently, affecting delay coloration more than plate resonance.

22.3 Noise Behavior: When to Use It

Noise in the BBD module provides: Authentic analog realism, Improved stereo image stability at low modulation rates, Slight masking of artifacts in high-feedback flanging.

- **When to turn it ON:** Vintage chorus, Flanger (Mistress, ADA, BF-2), Dub-style delays.
- **When to turn it OFF:** Modern clean presets, Precision vocal slapbacks, Ambient FX requiring low floor noise.

Noise has no effect when the BBD Power button is OFF.

22.4 Understanding Plate Types (Plate 0, 1, 2)

Internally, plate selection corresponds to three plate topologies.

- **Plate 0 = Small / bright:** Tighter low end, Fast decay. Ideal for snare, short vocal plates, univibe chorus trick.
- **Plate 1 = Medium:** Closest to EMT 140. Neutral; works on most sources.
- **Plate 2 = Large / smooth:** Modern ballads, pads, ambient vocals. Broad stereo image.

If in doubt, Plate 1 is the safest starting point.

22.5 MixType Selection Quick Guide

Choosing the correct blend law affects: perceived loudness, phase interaction, stereo width.

Recommended defaults

Effect Type	MixType
Plates (all styles)	Sin3 dB
Lexicon 224	Sin3 dB
Chorus (CE-1/CE-2)	Sin4.5 dB
Dimension-D	Balanced
Flanger (BF-2, ADA, Mistress)	Linear
TZF	Balanced
Slapback	Balanced (Insert) / Sin3 dB (Send)
Tonal delays (U2)	Balanced
Dub throw	Sin3 dB

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Output Compensation

- **Linear:** +5 to +6 dB
- **Balanced:** +1 to +3 dB
- **Sin4.5/Sin6:** +2 to +4 dB

22.6 Sync vs. Free Mode (ms Mode)

When Sync is ON

- Delay time is locked to host BPM
- Subdivision selector is active
- User **cannot switch to ms** until Sync is OFF

When Sync is OFF

- Delay time is shown in **ms**
- Users may still enter BPM values manually, but internally they behave as free delays

Memory Detail If a preset was saved in BPM mode then switched to ms, the numerical value may not match the perceived sound. Always set the knob explicitly after changing timing mode.

22.7 Avoiding Dry Signal Leakage in Delay-Off Presets

When building "Reverb Only" presets:

- **Correct Routing:** Series Mode (Delay OFF → no dry bleed).
- **Parallel Mode:** Delay OFF still passes dry signal through BBD path, causing unexpected summing. Therefore, series is mandatory for reverb-only presets.

22.8 Understanding the Three Saturation Stages

1. **BBD Saturator:** Behaves like preamp into analog delay chip. Adds midrange grit. Active only when BBD power is ON.
2. **Plate Saturator:** Alters excitation of the mechanical body. Subtle but helps vocals "sit" inside the plate.
3. **Output Saturator (P42 Engine):** Controls final tone of wet signal. Glue, harmonic density, presence. Gains more importance when MixType is Sin4.5 or Linear.

22.9 Gain Staging: Most Common Cause of "Wrong Sound"

To maintain consistency:

- Keep **plate input** within ±6 dB
- Keep **BBD input** between –6 and 0 dB for chorus/flanger

- Use **Master Out** for final level matching, not internal gain sliders

If a preset suddenly sounds “wrong,” compare: MixType, Plate Input, Damping, Bandwidth, Predelay, Routing. These five shape the identity more than anything else.

22.10 Why Some Presets Require High Output Gain

Linear MixType and Balanced MixType generate lower perceived loudness. This is normal.**Examples:** ADA Flanger → +6 dB, BF-2 → +5 dB, Jet Flanger → +5 dB, Dimension D → +2 dB, Chorus Sin4.5dB → +2 to +4 dB. This is expected behavior, not a bug.

22.11 Reading and Troubleshooting XML

Typical XML issues

- **Missing layer entries:** Some parameters revert to default when not included.
- **ClockRate vs clockrateunit mismatch:** If ms/BPM mode is not set properly, the dial reads wrong.
- **Preset loaded with different routing:** If Parallel/Series missing, plugin may assign defaults.
- **Timesign and Rythm not set:** Can break sync behavior even in reverb-only presets.
- **Plate Input showing “0 dB” but sounding louder:** GUI rounding: internally value may differ slightly.

22.12 Final Tips for Efficient Workflow

- Always decide **Plate Size + MixType** early.
- Tune **damping + LPF** before touching decay.
- For vocals, adjust **Plate Input** last.
- If a preset feels “too digital,” lower **plate input** and **widen bandwidth**.
- If tail feels metallic, lower input or increase damping.
- If spatial width collapses, adjust MixType or L/R offsets.

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23. Working With Templates and Starting Points

This section provides practical templates for quickly building reliable Lunar Lander presets. These are not “sounds,” but repeatable starting frameworks that help you design consistent plates, delays, mod FX, and hybrid spaces.

23.1. Vocal Plate Templates

23.1.1. Warm Vintage Vocal Plate (EMT-Style)

Use for ballads, crooners, spoken word, jazz.

- **Plate:** 1 (medium)
- **Plate Input:** –2 to –6 dB
- **Decay:** 2.0–2.7 s
- **Damping:** 3000–4000 Hz
- **Bandwidth:** 2–4
- **Predelay:** 10–20 ms
- **MixType:** Sin3 dB
- **Output Saturation:** 0–0.3
- **Purpose:** Smooth warmth without metallic ripple.

23.1.2. Modern Clear Vocal Plate (224-Inspired)

For pop, R&B, acoustic.

- **Plate:** 2
- **Plate Input:** 0 dB
- **Decay:** 3.0–4.0 s
- **Damping:** 5000–7000 Hz
- **Bandwidth:** 0–2
- **Predelay:** 20–40 ms

- **MixType:** Sin3 dB
- **Plate Saturation:** Minimal
- **Output Saturation:** 0.2–0.4
- **Purpose:** Airy, smooth top without harsh resonance.

23.1.3. Short Plate for Tight Vocals

Used for doubling, thickening, rap, punchy pop.

- **Plate:** 0
- **Plate Input:** –2 to 0 dB
- **Decay:** 1.2–1.8 s
- **Damping:** >6000 Hz
- **Predelay:** 0–10 ms
- **Bandwidth:** 3–5
- **MixType:** Sin3 dB
- **Purpose:** Intimacy without obvious reverb tail.

23.2. Delay Templates

23.2.1. U2 / The Edge Rhythmic Delay

Insert or send.

- **BBD Power:** On
- **Mode:** Ping-Pong
- **Clock:** Sync ON
- **Subdivision:** 1/8 or dotted 1/8
- **Bandwidth:** 2–5
- **BBD Saturation:** 0.2–0.5
- **MixType:** Balanced

- **Output gain:** +1 to +3 dB
- **Purpose:** Rhythmic clarity with stereo definition.

23.2.2. Classic Slapback

Vocals, guitar, synth.

- **BBD Power:** On
- **Sync:** Off
- **Clock (ms)::** 100–140 ms
- **Regen:** 0
- **Bandwidth:** 0–3
- **Input:** –2 to +2 dB
- **MixType:** Sin3 dB
- **Phase:** Normal or Invert (user taste)
- **Purpose:** Authentic analog slap that never rings or smears.

23.2.3. Dub / Throw Delay

Send FX for transitions.

- **BBD Power:** On
- **Sync:** On
- **Subdivision:** 1/4 or 1/2
- **Regen:** 30–70 percent
- **BBD Saturation:** 0.5–1.0
- **Noise:** On
- **MixType:** Sin3 dB
- **Purpose:** Classic dub repeats with controlled analog dirt.

23.3. Chorus, Flanger, Phaser Templates

23.3.1. Chorus (CE-1 / CE-2 Style)

- **BBD Power:** On
- **Mix:** 40–60 percent
- **Mod Rate:** 0.25–0.35 Hz
- **Mod Depth:** 2–4
- **Bandwidth:** 2–5
- **MixType:** Sin4.5 dB
- **Output gain:** +2 to +4 dB
- **Purpose:** Lush, wide, musical.

23.3.2. Dimension-D Style

- **BBD Power:** On
- **Mix:** 20–40 percent
- **Settings:** Low Depth, slow Rate
- **MixType:** Balanced
- **Output gain:** +2 dB
- **Purpose:** Width without motion.

23.3.3. Flanger (BF-2, ADA, Mistress)

- **BBD Power:** On
- **Regen:** 0.3–0.7
- **Mod Rate:** 0.1–0.25 Hz
- **Mod Depth:** High
- **MixType:** Linear
- **Output Gain:** +4 to +6 dB
- **Purpose:** Authentic analog sweep and headroom.

23.3.4. TZF (Through-Zero Flanger)

- **BBD Power:** On
- **Offset L/R:** ± small values
- **Depth:** Maximum
- **Rate:** Slow
- **MixType:** Balanced
- **Purpose:** Dramatic zero-cross cancellation.

23.4. Hybrid Templates (Plate + Delay)

23.4.1. Plate → Delay (EMT Vocal Plate + Slap)

This is the standard for most classic plate records.

- **Routing:** Rev → Dly
- **Plate:** 1
- **Plate Mix:** 100 percent
- **Delay Mix:** 10–35 percent
- **Delay Time:** 100–140 ms
- **Result:** Glued, authentic 60s/70s vocal ambience.

23.4.2. Delay → Plate (Lexicon-Style Ambience)

Used for 80s/90s modern vocal reverb.

- **Routing:** Dly → Rev
- **Delay:** Short, 20–60 ms
- **Plate:** 2
- **Decay:** 3–5 s
- **Damping:** High
- **Result:** Soft pre-diffusion before plate spill.

23.5. Template for Testing Plate Behavior

Useful when evaluating parameters or calibrating presets.

- **Plate:** 1
- **Input:** 0 dB
- **Bandwidth:** 0
- **Predelay:** 0
- **Decay:** 3.0 s
- **Damping:** 4000 Hz
- **Mix:** 100 percent
- **No saturation**
- **No BBD**
- **Series**
- **MixType:** Sin3 dB
- **Purpose:** This gives a neutral baseline for tuning resonance, damping, and decay characteristics.

23.6. Template for Modulation FX Without Delay "Leak"

If creating modulation FX using the plate:

- **Plate:** 0
- **Decay:** 0.3–0.6 s
- **Modepth:** Low
- **Rate:** Slow
- **Mix:** 30–60 percent
- **Phase:** Invert for width
- **Purpose:** This works because Plate 0 behaves like a tuned comb resonator when decay is minimal.

23.7. Universal Troubleshooting Template

When a preset sounds wrong, verify in this order:

1. Plate Type (0 / 1 / 2)
2. MixType
3. Routing (Series vs Parallel)
4. Plate Input Level
5. Damping / LPF
6. Bandwidth
7. Predelay
8. ClockMode (ms vs BPM)
9. BBD Power inadvertently ON
10. Output Gain too low for Linear/Balanced MixType

This checklist solves nearly all loading inconsistencies.

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24. Building Your Own Presets (Step-By-Step Method)

This section provides a structured workflow for designing consistent, great-sounding presets in P930 Lunar Lander. It prevents guesswork and ensures every preset loads predictably on any system.

24.1. Start With a Clean Baseline

Before shaping tone or time, reset the plugin to a neutral starting point:

- **Routing:** Series
- **BBD:** Off
- **Plate:** Type 1, Mix 100 percent
- **Decay:** 2.5–3.0 s
- **Damping:** 3500–4500 Hz
- **Predelay:** 0 ms
- **Bandwidth:** 0
- **Plate Input:** 0 dB
- **Output Saturation:** Off
- **MixType:** Sin3 dB
- **Main Out:** 0.0 dB
- **Purpose:** This establishes a consistent tonal reference for decision making.

24.2. Define the Preset Category

Ask yourself: Plate only? Delay only? Hybrid (Rev → Dly or Dly → Rev)? Modulation FX? Insert vs Send? . Your routing, mix rules, input levels, and gain structure depend entirely on this decision.

General rule:

- **Send FX:** Plate Mix = 100 percent, Delay Mix = 100 percent.
- **Insert FX:** Plate Mix = 10–60 percent, Delay Mix = 5–50 percent.

24.3. Choose the Correct Plate Type

Use a consistent logic:

- **Plate 0:** Short, tight, metallic. Good for: doubling, slap-enhanced ambience, modulation tricks .
- **Plate 1:** General-purpose EMT behavior. Good for: vocals, drums, instruments, natural plates .
- **Plate 2:** Longer, smoother, Lexicon-influenced behavior. Good for: pop, R&B, cinematic, lush tails .

24.4. Dial the Plate Input Level First

This is the most important decision when shaping tone.

- **+ input:** Excites the sheet, adds brightness, metallic shimmer, ripple tail.
- **− input:** Warms tone, softens diffusion, smooth tail.

Typical ranges:

- **Vocal warm:** –2 to –6 dB.
- **Pop modern:** –1 to +1 dB.
- **Bright plate:** +2 to +6 dB.

Note: Never skip this step. It determines the entire tonal direction before decay, damping, or bandwidth matter.

24.5. Set Decay, Damping, and Bandwidth

These three interact strongly.

- **Decay:** Controls the overall size. Typical: 1.2–4.5 s depending on category .
- **Damping / LPF:** Defines brightness of the tail. EMT-like plates: 3000–5000 Hz .
- **Bandwidth:** Controls how tight or wide the resonant structure is. 0 = full-range diffusion. 10 = very narrow, vintage early-plate behavior .

Note: Use Bandwidth sparingly. It easily shifts the plate from “modern” to “vintage”.

24.6. Add Predelay for Clarity

Predelay separates source from plate.

- **Tight vocals:** 0–10 ms.
- **Classic vocals:** 10–25 ms.
- **Large plate:** 25–40 ms.
- **Note:** Predelay is rarely wrong unless it exceeds 40 ms.

24.7. Decide on Routing: Series or Parallel

- **Rev → Dly (EMT workflow):** Classic 60s/70s style. Softens the plate .
- **Dly → Rev (Lexicon workflow):** Creates diffusion before the plate. Smooth, modern .
- **Parallel:** Used only when you want independent control of the two modules. Be careful: Delay OFF in parallel still passes dry signal. Sends require the plate AND delay to be 100 percent wet .

24.8. Choose the Correct MixType Blend Rule

Use the rules we validated through listening tests:

- **Sin3 dB:** General purpose. Best for: Plates, EMT 140, Lexicon 224, slapback, most sends .
- **Balanced:** Strong dry + strong wet. Best for: Dimension-D, TZF, stereo widening .
- **Linear:** True dry + wet with equal weighting. Best for: BF-2, ADA Flanger, Electric Mistress .
- **Sin4.5 dB:** Smooth transition with perceived loudness stability. Best for: CE-1, CE-2, analog choruses, gentle flangers .

Note: This decision has a major impact on preset-to-preset loudness matching.

24.9. Set Delay Timing Properly

- **Sync ON:** Delay clock is locked to BPM. Use for rhythmic delays, U2 style, dub throws .
- **Sync OFF:** Manual ms mode. Use for slapback, modulation, micro-delays .

Important: When switching between MS and BPM modes, always recheck the numerical value. The knob position does not translate automatically .

24.10. Add Saturation Correctly

Remember: Each module has its own saturator.

- **Plate Saturation:** Affects plate harmonics.
- **BBD Saturation:** Affects analog character of delays.
- **Output Saturation:** Affects the wet sum only.

Typical ranges:

- **Plates:** 0–0.3.
- **Delays:** 0.3–1.0.
- **Output:** 0.1–0.4.

24.11. Set Final Gain and Normalize the Preset

Establish output gain last.

Guidelines:

- **Sin3 dB** presets generally need 0 dB compensation.
- **Sin4.5 dB** presets need +2 to +3.5 dB.
- **Balanced** presets need +1 to +3 dB.
- **Linear** presets may need +4 to +6 dB.

Note: Be consistent so preset switching is level-safe.

24.12. Save and Validate

Before finalizing:

1. Toggle **SERIES ↔ PARALLEL** to ensure nothing leaks dry.
2. Switch **BPM ↔ MS** to ensure clock reads correctly.
3. Toggle **Plate Types 0/1/2** and revert to confirm correct behavior.
4. Lower and raise input by ±6 dB to test tail stability.
5. Switch **MixType** to Sin3 dB and back to confirm expected change.

If the preset stays clean through all tests, it is production-ready.

24.13. Recommended Build Order Checklist

Always follow this sequence:

1. Reset to baseline
2. Choose category
3. Select plate type
4. Set plate input
5. Tune decay / damping / bandwidth
6. Set predelay
7. Choose routing
8. Set MixType
9. Configure delay (if used)
10. Add saturation
11. Set output gain
12. Validate
13. Save

This guarantees repeatable, stable preset construction every time.

Appendix A: Full Parameter Reference

This appendix lists every operational parameter in P930 Lunar Lander in short, functional terms . It reflects the **final, verified behavior** discovered during development and preset design.

1. Global Controls

Parameter	Range	Description
Bypass	On/Off	Hard bypass for the entire plugin.
OS	On/Off	Oversampling, applied to reverb, BBD, and output saturation.
OS Type	Modes	Linear phase or minimum phase oversampling filter.
Module Order	Series / Parallel	Determines whether Delay feeds Reverb, Reverb feeds Delay, or both run in parallel.
Mix Type (Blend Law)	Linear, Balanced, Sin3dB, Sin4.5dB, Sin6dB, SR3dB, SR4.5dB	Defines how Dry and Wet combine. Affects tone, phase, and perceived level.
Main Out	Gain	Final output gain adjustment (post-wet path).

2. BBD Delay Section

Parameter	Range	Notes
Power	On/Off	Enables or disables the entire BBD unit.

Clock Rate	BPM or ms	ms available only when Sync is Off. Controls delay time.
Clock-Rate Unit	BPM / ms	Determines interpretation of Clock Rate.
Sync	On/Off	When on, delay follows DAW tempo and subdivisions.
Time Signature Box	Musical divisions	Standard musical fractions for tempo-synced delays.
BBD Input	±6 dB	Drives the BBD line. Higher levels give sharper transients, more grit.
Mix	0–100 %	Controls wetness of the delay path only.
HPF / LPF	Hz	Pre-filtering and tone shaping of repeats.
Bandwidth	0–10	Defines upper/lower limit span. Tightens or broadens BBD tone.
Regen	0–Max	Number of repeats.
Mod Rate	Hz	LFO rate for delay modulation.
Mod Depth	%	Extent of modulation sweep.
Offset L/R	ms	Stereo offset. Controls width or asymmetry.
Phase Flip	On/Off	Inverts delay polarity. Essential for doubling, widening, and classic flanger textures.

BBD Noise	On/Off / dB	Optional analog noise modelling. 0 dB is loudest. Lower values reduce noise.
Saturation	0–10	Applies P42-style soft clipping to the wet path of the BBD only.
Output	± dB	Output trim of the BBD wet path.

3. Plate Reverb Section

Parameter	Range	Notes
Power	On/Off	Activates the reverb engine.
Plate Size	0 / 1 / 2	Selects Plate 0 (short), Plate 1 (classic), Plate 2 (large).
Input	±6 dB	Controls how hard the virtual plate is excited. More input yields brighter tone and noticeable “metal ripple”. Lower input sounds warmer.
Predelay	ms	Time between dry signal and onset of reverb.
Decay	Seconds	Tail length. Range depends on Plate Size.
Damping	Hz	High-frequency rolloff within the tail.
HPF / LPF	Hz	Defines bandwidth of the plate excitation.
Bandwidth	0–10	Narrows or widens excitation band relative to HPF/LPF. Higher values = tighter, resonant plate signature.

Diffusion 1 / Diffusion 2	%	Controls early density and tail texture.
Saturation	0–10	Adds plate-specific harmonic enhancement to the wet signal path only.
Mix	0–100 %	Controls wetness of the reverb path only.
Output	± dB	Trim control for the reverb wet path.
Timesign Box	Divisions	For DAW-sync predelay if lock is enabled.
Lock to DAW	On/Off	Couples predelay rhythm to DAW grid.
Rythm Slider	0	Not used actively unless future rhythmic modes are enabled.

4. Output & Routing Controls

Parameter	Range	Notes
Parallel Button	On/Off	When Off, signal flows in series. When On, dry splits into independent Delay and Reverb paths.
Polarity Flip (Out)	On/Off	Flips the final wet polarity for tone correction or widening.
Output Saturation (P42)	0–10	Third saturation stage, applied after BBD and Plate paths, only to the wet signal.
Output Gain	dB	Final level.

5. Ducking Engine

Parameter	Range	Notes
Mode	Delay / Reverb / Both / Main Output	Selects which module is ducked.
Threshold	dB	Level at which ducking activates.
Ratio	Up to ~20:1	Strength of ducking.
Release	ms	Recovery time.
Attack/Knee	Not user adjustable	Internally tuned for musical operation.
Position	Pre/Post	Decides if ducker is placed before or after the effect path.

Appendix B: Troubleshooting Guide

1. Effect too bright or metallic

- Reduce **Plate Input** by 1–3 dB.
- Increase **Damping** or lower **LPF**.
- Reduce **Plate Bandwidth**.

2. Reverb tail ripples or rings

- Caused by high **Plate Input**.
- Reduce by 2–6 dB depending on material.

3. Parallel routing sounds phasey

- Check **Mix Type** (Sin3dB is neutral).
- Ensure **Delay Mix** or **Reverb Mix** are not partly wet when parallel was intended.

4. Level jumps when switching blend rules

- Increase or decrease **Main Out** by 2–4 dB depending on MixType.
- Balanced and Linear are hotter.

5. Delay switching between BPM and ms gives unexpected times

- Verify **Sync** is Off to use ms.
- Check that **Clockrate Unit** is set correctly.
- Some presets store clock positions but not the intended unit.

6. Reverb disappears when using Parallel

- If Delay is Off in parallel mode, no wet path feeds the reverb unless Series is selected.
- For pure plate: turn **Parallel Off**.

7. DAW automation sounds stepped

- Use **OS On** for smoother parameter transitions.
- Avoid extreme Mod Depth at very slow LFO rates.

Appendix C: Glossary of Key Terms

Term	Meaning
BBD	Bucket-brigade analog delay line simulation.
Clock Rate	Internal timing frequency determining delay time.
Plate Size	Selects between short, classic, and large plates.
Bandwidth	Controls how narrow or broad the excitation band is relative to HPF/LPF.
Diffusion	Determines density build-up in early reflections and tail.
Mix Type / Blend Law	Mathematical curve controlling dry/wet summing.
Parallel Routing	Dry splits into independent Delay and Reverb paths.
Series Routing	One module feeds into the next (Dly → Rev).
Duck	Attenuates effect when input signal exceeds threshold.
Ping Pong	Alternating left/right delay propagation.
Saturation	P42-style harmonic enhancement.

Appendix D: System Notes

1. Plugin Formats

- AU, VST3, AAX, AUv3.
- macOS and Windows native.

2. DAW Considerations

- **ms delay** depends only on knob position.
- **BPM delay** requires DAW transport or BPM value.
- Some DAWs buffer automation differently; oversampling improves smoothness.

3. CPU Notes

- Plate Size 2 and high Diffusion are heaviest.
- BBD modulation at high rates also adds CPU.
- Oversampling doubles CPU use.

4. Preset Compatibility

- Older presets missing certain parameters default to safe values.
- Presets created in version 2.0+ include proper Clockrate Unit and MixType tagging.

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