LUMA Film Simulation Feature

Implementation report, preset catalog, and current reference renders

This document summarizes the shipped film simulation feature in LUMA, the processing model behind it, the editor control surface exposed to the user, and the current reference render for each film preset.

Report date: March 7, 2026

Generated from workspace assets in Docs/FilmSimulationReport/assets

1. Feature Summary

The film simulation feature turns the Lab preset system into a stock-inspired RAW finishing layer rather than a fixed JPEG colour effect. Every film preset remains a normal LABPreset, so the user can inspect it, edit it, duplicate it, or strip it back to a flatter starting point.

The implementation is built around LUMA's Bayer RAW pipeline. Scene data is developed from the RAW source, shaped through the preset stack, and then delivered into the app's processed-image path. This keeps exposure, white balance, palette shaping, grain, halation, monochrome translation, and print response inside the same non-destructive model.

The goal is not a laboratory-perfect reproduction of sensitometric curves. The goal is a convincing, editable photographic interpretation that fits LUMA's existing control surface and performs reliably on-device.

Shipped Scope

- 14 film presets grouped by family: Kodak negatives, CineStill cinema negatives, Fujifilm colour stocks, and monochrome stocks.
- Short user-facing preset names while leaving internal class names and IDs stable.
- New editor controls for palette, texture, halation, grain, monochrome channel mix, and print/scan response.
- A report reference set that compares each film preset against Flat and Sensei on the same source frame.
- A checked-in RAW render harness for repeatable tuning against Bayer RAW samples.

Preset Index

Kodak colour negatives

- Muse, Daytrip, Honey, Ember

CineStill cinema negatives

- Solar, Neon

Fujifilm colour stocks

- Sage, Breeze, Glide, Lush

Monochrome stocks

- Silver, Noir, Grit, Static

2. Processing Model

The film presets are layered into the existing LAB processor rather than treated as a separate export effect. The active order is intentionally stable so that the stock response, print response, and detail response do not fight each other.

Pipeline Order

- Linear RAW stage: exposure, temperature, tint, vibrance, and non-monochrome saturation/contrast/brightness.
- Non-linear tone stage: highlight and shadow shaping.
- Colour shaping stage: colour grade cube and hue-selective warm/green/blue response.
- Tone curve stage: film-style shoulder, black lift, and midtone placement.
- Monochrome stage: optional red/green/blue channel weighting for black-and-white stocks.
- Print/scan stage: optional strength, warmth, contrast, and fade layer applied after stock shaping.
- Detail stage: acutance and chroma softness, followed by halation and grain where appropriate.

Manual Control Surface

- Palette: warm, green, and blue hue/saturation/luminance response.
- Texture: acutance plus chroma softness for less digital edge behaviour.
- Halation: amount, threshold, radius, and warmth.
- Grain: amount, size, roughness, and colour.
- Monochrome: red, green, and blue channel weighting.
- Print/Scan: strength, warmth, contrast, and fade.

The monochrome mixer sits after stock colour shaping so black-and-white presets still benefit from the RAW colour information before it is collapsed into grayscale. The print/scan layer sits after stock response so it behaves like a finishing pass rather than a replacement for the stock itself.

3. Tuning and Validation

Tuning Approach

- Tuning relied on Canon EOS 5D Mark III, Leica Q2, Google Pixel 7 Pro, Nikon Z f, and iPhone 12 Pro RAW files during development. The report asset set uses Canon, Leica, and Pixel references that are currently stored in the workspace.
- Stock behaviour was aligned by comparing characteristic scene responses: skin warmth, foliage bias, blue-cyan separation, highlight rolloff, halation visibility, monochrome colour translation, and the amount of print-like fade required to avoid a purely digital finish.
- The simulations are intentionally interpretive. Grain and halation are procedural approximations, and the print layer is a controlled finishing pass rather than a strict emulation of any single lab scanner.

Validation

- Build validation succeeded for both the processing package and the full iOS project.
- The RAW harness was rerun after the monochrome mixer and print/scan layer landed, and all 14 presets were rendered again for the reference pack in this report.
- Reference images in this PDF are engineering previews generated from the current preset definitions. They are appropriate for review and regression tracking, not for claiming exact film chemistry matches.

Reference Render Inputs

- Canon EOS 5D Mark III RAW: canon_5d3_9394.dng
- Leica Q2 RAW: leica_q2_l1000750.dng
- Google Pixel 7 Pro RAW: pixel7pro.dng

Muse

Kodak Portra 400

Family: Kodak colour negative

Design Intent

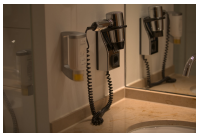
Soft portrait negative with warm skin response, gentle highlight rolloff, and subdued greens. Designed to feel open and polished rather than punchy.

Key Tuning Notes

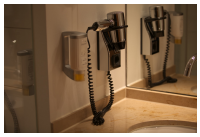
- Print layer softened contrast and added a mild warm paper bias.
- Chroma softness keeps colour edges from reading digitally crisp.
- Grain stays restrained so the preset remains clean in midtones and skin.

Muse

Flat and Sensei comparison thumbnails



Flat



Sensei

Reference render input: Canon EOS 5D Mark III DNG (canon_5d3_9394.dng)

Daytrip

Kodak ColorPlus 200

Family: Kodak colour negative

Design Intent

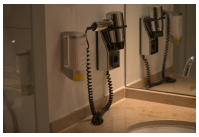
Warm consumer-negative look with lighter contrast, softer colour separation, and a relaxed, slightly faded print feel.

Key Tuning Notes

- Print strength is higher than Muse to emphasize consumer-lab softness.
- Warm palette response pushes yellows and oranges without making reds neon.
- Grain and fade are both visible so it does not overlap too closely with Honey.

Daytrip

Flat and Sensei comparison thumbnails



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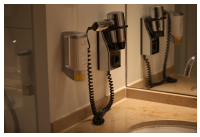


Sensei

Reference render input: Canon EOS 5D Mark III DNG (canon_5d3_9394.dng)

Honey

Kodak Gold 200

Family: Kodak colour negative

Design Intent

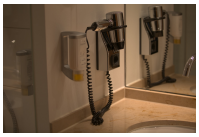
Poppier Kodak consumer colour with amber warmth, firmer contrast, and brighter yellow-red highlights than Daytrip.

Key Tuning Notes

- Print warmth is stronger than the rest of the Kodak negative family.
- Warm hue and saturation response are pushed harder to get the Gold-style amber bias.
- Contrast and highlight shaping are intentionally firmer so the preset has more snap than Muse.

Honey

Flat and Sensei comparison thumbnails



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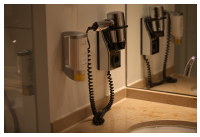


Sensei

Reference render input: Canon EOS 5D Mark III DNG (canon_5d3_9394.dng)

Ember

Kodak Ektar 100

Family: Kodak colour negative

Design Intent

Clean, saturated negative with strong reds and deep blues. The goal is a polished, low-grain colour stock rather than a nostalgic print.

Key Tuning Notes

- Acutance is higher and chroma softness is lower than the softer negative stocks.
- Print layer is lighter so the stock keeps its cleaner, more contrasty character.
- Warm and blue sectors both get positive saturation to support Ektar-like colour pop.

Ember

Flat and Sensei comparison thumbnails

Flat

Sensei

Reference render input: Leica Q2 DNG (leica_q2_l1000750.dng)

Solar

CineStill 400D

Family: CineStill daylight cinema negative

Design Intent

Daylight cinema-negative look with controlled warmth, moderate halation, and a cleaner cine palette than the Kodak consumer presets.

Key Tuning Notes

- Halation is present but restrained so highlights bloom without swallowing edges.
- Print layer stays modest and neutral-warm to keep the preset readable in daylight scenes.
- Grain is more active than Kodak still negative stocks, but less aggressive than Neon.

Solar

Flat and Sensei comparison thumbnails

Flat

Sensei

Reference render input: Leica Q2 DNG (leica_q2_l1000750.dng)

Neon

CineStill 800T

Family: CineStill tungsten cinema negative

Design Intent

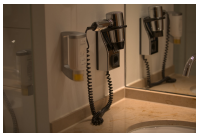
Tungsten-balanced cine look with cooler shadows, warm practical highlights, stronger red halation, and visibly rougher grain.

Key Tuning Notes

- Halation amount, radius, and warmth are all elevated to separate it from Solar.
- Blue sector response is pushed cooler and more saturated for the signature tungsten bias.
- Print contrast is positive so the scene keeps energy even with strong halation and grain.

Neon

Flat and Sensei comparison thumbnails



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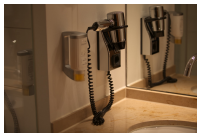


Sensei

Reference render input: Canon EOS 5D Mark III DNG (canon_5d3_9394.dng)

Sage

Fujifilm Pro 400H

Family: Fujifilm colour negative

Design Intent

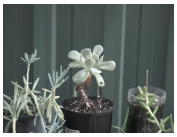
Pastel Fuji negative with cooler greens, open mids, and softer contrast than Kodak portrait stocks.

Key Tuning Notes

- Print layer slightly cools and fades the frame to preserve the airy Pro 400H feel.
- Green luminance is lifted so foliage stays bright without becoming dense or muddy.
- Texture remains soft; this preset should feel smooth before it feels sharp.

Sage

Flat and Sensei comparison thumbnails



Flat

Sensei

Reference render input: Google Pixel 7 Pro DNG (pixel7pro.dng)

Breeze

Fujifilm Superia X-TRA 400

Family: Fujifilm colour negative

Design Intent

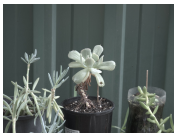
Cooler Fuji consumer colour with punchier greens and stronger colour contrast than Sage, while staying less amber than Kodak Gold.

Key Tuning Notes

- Green and blue palette sectors are more assertive than the rest of the Fuji group.
- Print layer adds only a small fade so the preset stays lively and retail-film-like.
- Grain and acutance are both stronger than Sage to keep the look more casual and energetic.

Breeze

Flat and Sensei comparison thumbnails



Flat

Sensei

Reference render input: Google Pixel 7 Pro DNG (pixel7pro.dng)

Glide

Fujifilm Provia 100F

Family: Fujifilm slide film

Design Intent

Balanced slide-film treatment with clean contrast and moderate saturation. Intended as the neutral chrome counterpart to Lush.

Key Tuning Notes

- Print layer is intentionally light so the chrome character remains intact.
- Acutance is elevated to keep edges and fine detail crisp.
- Colour response is tuned to stay believable in blues and cyans without crossing into Velvia intensity.

Glide

Flat and Sensei comparison thumbnails

Flat

Sensei

Reference render input: Leica Q2 DNG (leica_q2_l1000750.dng)

Lush

Fujifilm Velvia 50

Family: Fujifilm slide film

Design Intent

High-impact slide look with deep blues, dense greens, and harder contrast. This is the most vivid colour preset in the set.

Key Tuning Notes

- Print layer is barely present so the stock keeps its chrome punch.
- Acutance is the highest in the film pack to support a sharper transparency feel.
- Green and blue sector saturation are both deliberately strong to create the Velvia signature.

Lush

Flat and Sensei comparison thumbnails

Flat

Sensei

Reference render input: Leica Q2 DNG (leica_q2_l1000750.dng)

Silver

Ilford FP4 Plus

Family: Monochrome negative

Design Intent

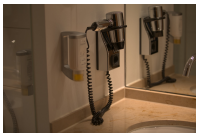
Open, fine-grain monochrome preset with gentler contrast and more highlight room than the other black-and-white stocks.

Key Tuning Notes

- Monochrome channel mix favours green slightly to keep foliage and skin open.
- Print contrast is negative and print fade is positive to avoid an overly hard scan look.
- Grain is deliberately small and calm so the preset stays clean at normal viewing sizes.

Silver

Flat and Sensei comparison thumbnails



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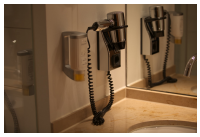


Sensei

Reference render input: Canon EOS 5D Mark III DNG (canon_5d3_9394.dng)

Noir

Ilford HP5 Plus

Family: Monochrome negative

Design Intent

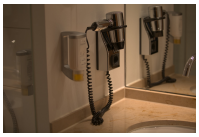
Classic medium-speed Ilford black-and-white look with fuller blacks and more grit than Silver, but less bite than Grit.

Key Tuning Notes

- Monochrome mix adds red and subtracts blue to create a slightly stronger tonal translation than Silver.
- Print layer adds a touch of contrast without making highlights brittle.
- Grain roughness increases enough to separate it from FP4 while remaining manageable.

Noir

Flat and Sensei comparison thumbnails



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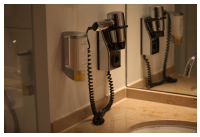


Sensei

Reference render input: Canon EOS 5D Mark III DNG (canon_5d3_9394.dng)

Grit

Kodak Tri-X 400

Family: Monochrome negative

Design Intent

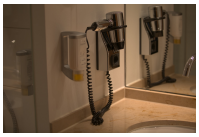
Harder-edged Kodak black-and-white preset with deeper blacks, stronger print contrast, and a tougher tonal curve.

Key Tuning Notes

- Monochrome mix leans red and pulls blue down harder than the Ilford presets.
- Print contrast is the strongest among the monochrome group, with very little fade.
- Grain is rougher and more visible so the preset does not read as a clean studio black-and-white conversion.

Grit

Flat and Sensei comparison thumbnails



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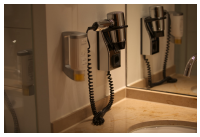


Sensei

Reference render input: Canon EOS 5D Mark III DNG (canon_5d3_9394.dng)

Static

Ilford Delta 3200

Family: High-speed monochrome negative

Design Intent

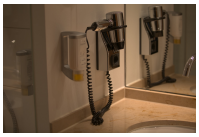
High-speed monochrome preset with lifted lower mids, strong grain, and a softer shoulder than Grit so it can still breathe in highlights.

Key Tuning Notes

- Grain amount, size, and roughness are the highest in the monochrome group.
- Print fade is slightly higher than Noir or Grit to keep the preset from looking simply crushed.
- The monochrome mix stays assertive but not as hard as Tri-X, which helps preserve the rough high-speed character.

Static

Flat and Sensei comparison thumbnails



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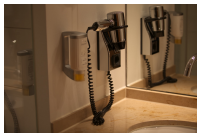

Sensei

Reference render input: Canon EOS 5D Mark III DNG (canon_5d3_9394.dng)