Touchstone Monitor & Reference: Operation Manual

Version: 1.0.1
Device Classification: Studio Effect (`Audio Meter` , `Stereo` , `Misc`)
Rack Format: 4U Full-Width Console (collapses to active 1U folded strip)
Supported Platforms: Reason 10.1 or later (macOS Universal Apple Silicon/Intel & Windows 64-bit, Standalone DAW & Reason Rack Plugin)
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1. Overview & Signal Architecture

Touchstone brings a dedicated studio control room, 4-slot loudness-matched reference deck, 5-band phase-aligned solo matrix, headphone crossfeed and room simulator, and 4-view mastering meter into Reason's Master Section.

Because Reason's Master Section doesn't include a separate non-bouncing monitor bus, leaving a reference player, mono switch, or headphone filter active on `Master Out 1/2` prints straight into your exported audio file. Touchstone solves that with five independent stereo output buses, normalled dual-bus `Main Mix In` / `Ctrl Room In` inputs, automatic BS.1770-4 loudness matching, and continuous side-by-side Mix vs. Reference metering even while you stay on `Live Mix` .

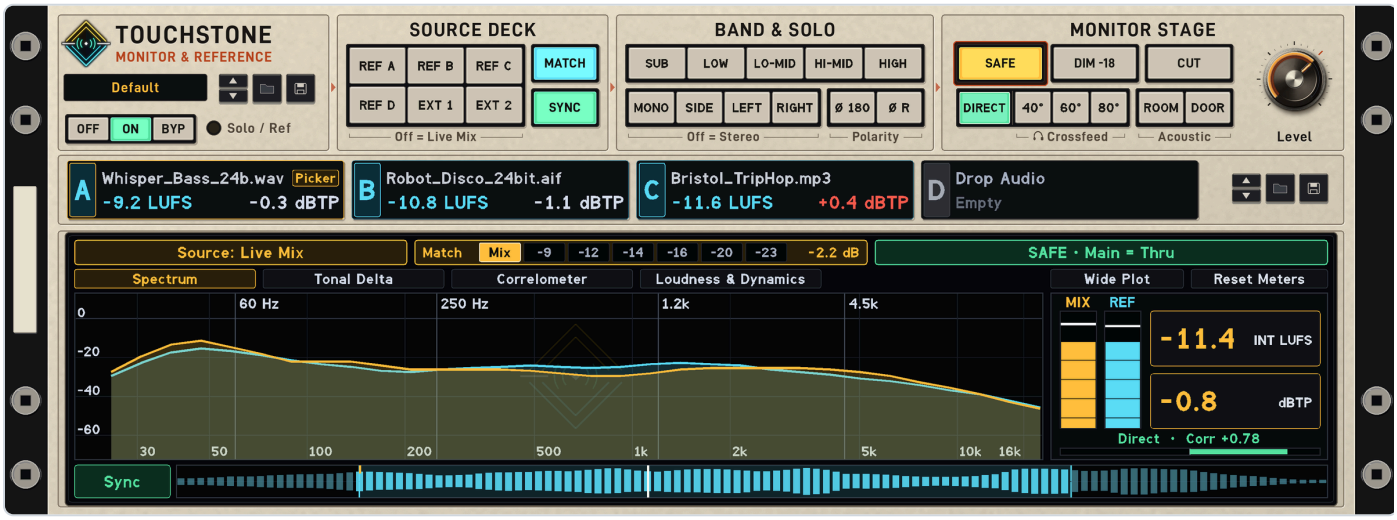

Figure 1: Touchstone 4U Front Panel (Spectrum RTA, Reference Cartridges & Meter Bridge)

1.1 Signal Flow & Tap Points

Every rear output and internal meter taps a dedicated point in the signal chain so external analyzers, headphone outputs, and song bounces never step on each other:

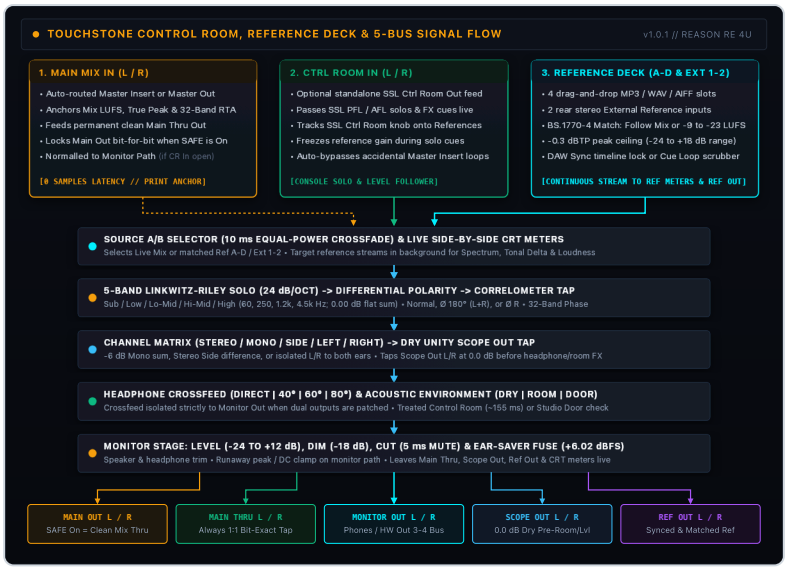

Figure 2: Touchstone Dual-Bus Inputs, Reference Deck, Monitor Chain & 5 Independent Stereo Outputs

1.2 Output Bus & Meter Immunity Summary

Tap / Bus	Source A/B + Match	5-Band Solo	Polarity (Ø 180 / Ø R)	Channel (Mono/Side/L/R)	Crossfeed (40° to 80°)	Acoustic (Room/Door)	Dim / Cut / Level / Fuse
`Main Out` (`SAFE` On)	No (Bit-Exact Thru)	No	No	No	No	No	No
`Main Out` (`SAFE` Off, Single Out)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
`Main Out` (`SAFE` Off, Dual Out)	Yes	Yes	Yes	Yes	**No** (Phones only)	Yes	Yes
`Main Thru Out`	No (Always Bit-Exact)	No	No	No	No	No	No
`Monitor Out`	Yes	Yes	Yes	Yes	Yes	Yes	Yes
`Scope Out`	Yes	Yes	Yes	Yes	No	No	No (0.0 dB unity)
`Ref Out`	Latched Ref + Match	No	No	No	No	No	No
Mix & Ref Meters / RTA / Delta	Mix = raw, Ref = matched	Visual shade	No	No	No	No	No
32-Band Correlometer	Yes	Yes	Yes	No (pre-Mono/Side)	Yes (when single out)	No	No

2. Front-Panel Guided Tour (4U Console & 1U Folded Strip)

Touchstone's 4U console is organized into three horizontal tiers: **Tier 1** (Upper Tactile Console), **Tier 2** (4-Slot Reference Deck), and **Tier 3** (Full-Width Mastering CRT). Every radio button group uses **click-to-toggle-off** behavior: click an unlit button to engage it, and click the active button again to return straight to its flat default state.

2.1 Bay 1: Identity, Patch Browser & Power

- **Patch Display & Browser**: Loads and saves `.repatch` presets across all 8 factory control room setups.
- `OFF | ON | BYP` **Power Switch**:
  - `OFF` (red): Mutes all outputs cleanly and shows a red `Power Off` banner on the CRT.
  - `ON` (green): Normal active control room operation.
  - `BYP` (amber): Passes `Main Mix In` straight through `Main Out`, `Main Thru`, and `Scope Out` and shows `Bypassed` on the CRT.
- `Solo / Ref` **Warning Lamp**: Lights amber whenever non-flat monitoring (Reference playback, Band Solo, Mono/Side/L/R, Polarity, Crossfeed, Room/Door, Dim, Cut, non-unity Level, or `Ctrl Room In`) is audible on `Main Out` with `SAFE` turned off. Turns off automatically whenever `SAFE` protects `Main Out`.

2.2 Bay 2: Source Deck (`REF A` through `REF D`, `EXT 1` & `EXT 2`, `MATCH`, `SYNC`)

- `REF A` **through** `REF D` **(cyan)**: Auditions any loaded reference track with a click-free 10 ms equal-power crossfade. Click the lit button again to return to `Live Mix`.
- `EXT 1` **&** `EXT 2` **(amber)**: Switches to the rear stereo External Reference inputs (`Ext Ref 1 L/R`, `Ext Ref 2 L/R`), metered live for loudness matching.
- `MATCH` **(cyan)**: Enables ITU-R BS.1770-4 loudness matching across `Ref A` through `Ref D` and `Ext 1` / `Ext 2`. Target selection lives in the CRT Row A `Match` pill:
  - `[Mix]` (`Follow Live Mix`, **default)**: Scales references (-24.0 to +18.0 dB) to match your live mix's loudness, guarded by a -0.3 dBTP peak ceiling so quiet acoustic mixes never clip loud masters.
  - **Fixed & K-System Targets (`[-9]`, `[-12]`, `[-14]`, `[-16]`, `[-20]`, `[-23]`)**: Locks references right away to -9 LUFS (Loud/Club), -12 LUFS (K-12), -14 LUFS (K-14 / Streaming), -16 LUFS (Apple / AES), -20 LUFS (K-20), or -23 LUFS (EBU R128) even when your mix is stopped, while keeping `Live Mix` untouched at 0.0 dB unity. Clicking any target chip while `MATCH` is off enables `MATCH` in one click; clicking an active fixed chip returns to `Mix`.
- `SYNC` **(green)**: Switches between `DAW Sync` (lit) and `Cue Loop` (unlit):
  - `DAW Sync`: Locks reference playback to Reason's song timeline. Jumping to Bar 49 in the sequencer jumps to the matching timestamp in your reference track, shifted by your `Cue Position` waveform offset so intros and drops line up.
  - `Cue Loop`: Transport-independent continuous looping that honors Reason Sample Editor **Play Range** and **Loop Range** markers so you can loop and scrub choruses while Reason's transport is stopped.

2.3 Bay 3: Band & Solo Matrix

- **5-Band Solo (`SUB | LOW | LO-MID | HI-MID | HIGH`)**: Phase-aligned 24 dB/oct Linkwitz-Riley splits at **60 Hz**, **250 Hz**, **1.2 kHz**, and **4.5 kHz** (`Sub` below 60 Hz, `Low` 60 to 250 Hz, `Lo-Mid` 250 Hz to 1.2 kHz, `Hi-Mid` 1.2 to 4.5 kHz, `High` above 4.5 kHz) summing to 0.00 dB flat across any single band or multi-band combination:
  - Click one band to solo it; click the active band again to return to **Full Range**.
  - `Shift + Click` adds or removes individual bands (combining all five returns to Full Range).

    - **Click and drag** horizontally across buttons to sweep any contiguous band span.
- **Channel Solo (`MONO | SIDE | LEFT | RIGHT`)**: -6 dB constant-voltage `MONO` sum, stereo `SIDE` difference, or isolated `LEFT` / `RIGHT` routed to both ears.
- **Differential Polarity (`Ø 180 | Ø R`)**: Applied right *before* the Channel Matrix and Correlometer. `Ø 180` inverts both Left and Right; `Ø R` inverts only the Right channel to diagnose out-of-phase stereo stems that cancel in mono.

2.4 Bay 4: Monitor Stage

- `SAFE` **(Armored Amber)**: Locks `Main Out L/R` to bit-for-bit `Main Mix In` passthrough (0.00 dB, 0 samples latency).
- `DIM –18` **(cyan)** & `CUT` **(red)**: -18.0 dB monitor pad and click-free 5 ms monitor mute (`Main Thru` , `Scope Out` , `Ref Out` , `SAFE` -locked `Main Out` , and all CRT meters keep running uninterrupted).
- **Headphone Crossfeed (`DIRECT || 40° | 60° | 80°`)**: Models speaker-triangle interaural timing and head-shadow roll-off across **40°** (Nearfield), **60°** (Equilateral), and **80°** (Wide Mains) while keeping mono sub-bass calibrated to 0.0 dB. When both `Main Out` and `Monitor Out` are patched, Crossfeed isolates automatically to `Monitor Out` (`Phones` footer tag).
- **Acoustic Environment (`ROOM | DOOR`)**:
    - `ROOM` (green): Adds treated studio control-room early reflections and a tight ~155 ms decay voiced for closed-back headphones, staying loudness-neutral (within ±0.20 LU) and leaving sub-60 Hz bass clean.
    - `DOOR` (amber): Simulates listening through a closed solid-core studio door from the hallway outside so you can judge vocal-to-bass balance in seconds.
    - Both modes apply only to `Monitor Out` and un-safe `Main Out` (leaving `SAFE` `Main Out` , `Main Thru` , `Scope Out` , `Ref Out` , and all meters completely dry) and drop to 0% CPU when `Dry` .
- `Level` **(-24.0 to +12.0 dB, default 0.0 dB)**: Smooth rotary monitor trim (`Cmd/Ctrl + Click` resets to 0.0 dB).
- **Ear-Saver Fuse**: Protects your ears and monitors on the monitor path by clamping runaway spikes above +6.02 dBFS or heavy DC offsets and latching `FUSE! Reset` on the CRT until clicked. Normal audio below +6.02 dBFS passes untouched.

2.5 Tier 2: Reference Cartridges & Sample Management

- **4 Reference Cartridges (`A` through `D`)**: Each card shows its slot tab (bright cyan = active source, dark cyan = loaded, amber outline = Sample Browser target, dark slate = empty), filename, `Active` / `Picker` badge, and unmatched **Integrated LUFS** and **dBTP** true peak.
- **Song-Length Playback & Sample Editor Trim**: Drop full-length MP3, WAV, or AIFF tracks onto any card across any project sample rate (22.05 to 192 kHz). Click **Edit Sample** in the right-hand Sample Browser to set **Play Range** or **Loop Range** markers for chorus-to-chorus `Cue Loop` checks.
- **Keeping Self-Contained `.reason` Song Files Small**: When Reason saves a self-contained song, loaded reference samples are bundled inside the `.reason` file (a 4-minute 24-bit/48 kHz WAV adds ~65 MB). Select unused slots (`Picker`) and click **Delete Sample** in the Sample Browser before archiving or sharing `.reason` projects.

2.6 Compact 1U Folded Strip

Fold Touchstone in the rack to save vertical space while keeping everyday control room switches right on the 1U faceplate: `OFF / ON / BYP` , Patch Browser, `A` through `D` and `E1` / `E2` source chiclets, `SUB / LOW / LM / HM / HI` band solo buttons, `XFEED` toggle, armored `SAFE` , mini `Level` trim, and a 385 × 65 px scribble tape.



Figure 3: Touchstone 1U Compact Folded Rack Strip

3. Mastering CRT Views & `Wide Plot` Metering

Tier 3 houses a full-width vector CRT organized into four rows:

- **Row A (Status Header)**: `Source` pill (click to cycle), `Match [Mix] [-9] [-12] [-14] [-16] [-20] [-23]` target and gain pill, and `SAFE • Main = Thru` / `LIVE • Monitor on Main` status pill.
- **Row B (Mode & Action Bar)**: Mode tabs (`Spectrum` , `Tonal Delta` , `Correlometer` , `Loudness & Dynamics`), center active status badge (`CUT` , `Control Room` , `Studio Door` , or `Solo: ...` ; click any badge to clear), `Wide Plot` toggle, and `Reset Meters` (`FUSE! Reset` in red when tripped).
- **Row C (Main Canvas & Meter Bridge)**: Shared 25 Hz to 18 kHz logarithmic frequency grid with 60 Hz, 250 Hz, 1.2 kHz, and 4.5 kHz band split lines. When `Wide Plot` is off on the first three views, the right **Meter Bridge** shows `MIX` and `REF` peak/RMS bars, large `INT LUFS` and `dBTP` cards (click to reset), active monitor state, and a broadband `Corr` phase bar.
- **Row D (Waveform Scrubber)**: Clickable `Sync` / `Cue` pill beside a 116-bar reference waveform showing Sample Editor loop markers, live Target Reference playhead (active even while listening to `Live Mix`), and draggable `Cue Position` marker (`Shift + Drag` for fine scrubbing).

3.1 `Spectrum` (32-Band Dual RTA)

Overlays your **Live Mix** (amber) and **Target Reference** (cyan) across 32 1/3-octave filter bands (25 Hz to 18 kHz, 0 to -60 dB scale) with shaded solo highlights whenever `Band & Solo` is active.

3.2 `Tonal Delta` (Mix Minus Ref Curve)

Plots the spectral difference `Mix − Ref` across ±12 dB:

- **Amber fill above 0 dB**: Your mix has more energy than the reference in that band.
- **Cyan fill below 0 dB**: Your mix is quieter than the reference in that band.
- **±3 dB Sweet-Spot Corridor**: Shaded target band around 0 dB so you can spot tonal tilt imbalances without clicking away from `Live Mix` .

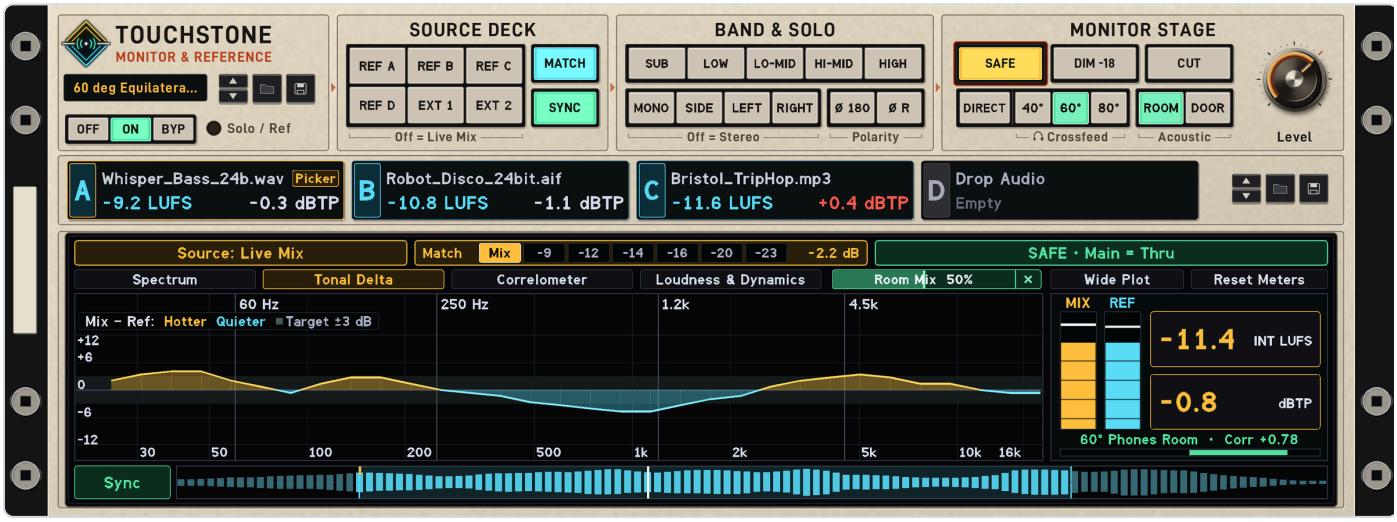

Figure 4: Tonal Delta View with 60° Headphone Crossfeed & Treated Control Room Active

3.3 `Correlometer` (32-Band Spectral Phase)

Measures per-band Left/Right phase correlation across all 32 bands, tapped **after Polarity (`Ø 180` / `Ø R`) and before Channel Matrix (`Mono` / `Side`)** so you can inspect underlying stereo phase even while monitoring in Mono. **Green bars toward +1** show mono-compatible energy; **red bars toward -1** warn of phase cancellation.

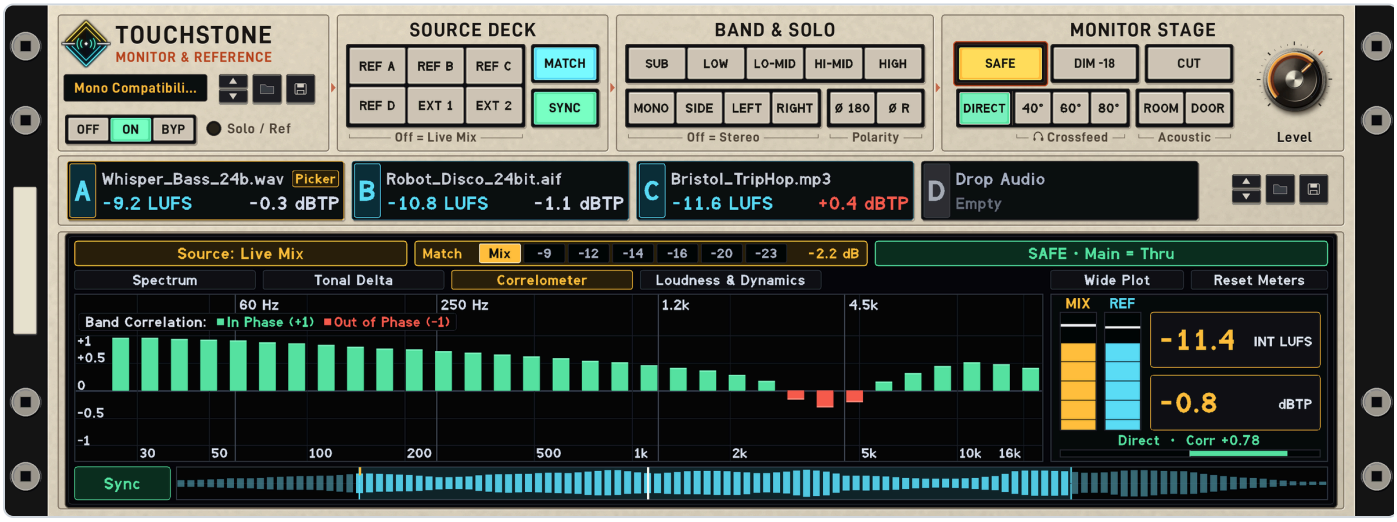

Figure 5: Correlometer View (32-Band Spectral Stereo Phase Bars)

3.4 `Loudness & Dynamics` (Split Matrix & `Wide Plot` 7-Card Mode)

- **Compact Split Layout (`Wide Plot` Off)**: Twin horizontal -60 to +3 dB Mix and Reference lanes on the left, paired on the right with a 5×2 `MIX` vs. `REF` table comparing `INT` (Integrated LUFS), `SHORT` (3 s Short-Term LUFS), `LRA` (Loudness Range in LU), `TP` (4x True Peak in dBTP), and `PSR` (Peak-to-Short-Term Ratio: green ≥ 8.0 LU `Dynamic`, amber 5.5 to 8.0 LU `Tight`, red < 5.5 LU `Squashed`).
- **Full-Width LPM Layout (`Wide Plot` On)**: Stretches twin broadcast meter lanes (-54 to +3 dB) across the full screen above **7 equal-width readout cards**: `MOMENTARY`, `SHORT TERM`, `INTEGRATED`, `LOUD RANGE`, `MATCH GAIN`, `TRUE PEAK`, and `PSR DYNAMICS`. Click any card or matrix cell to reset all meters.

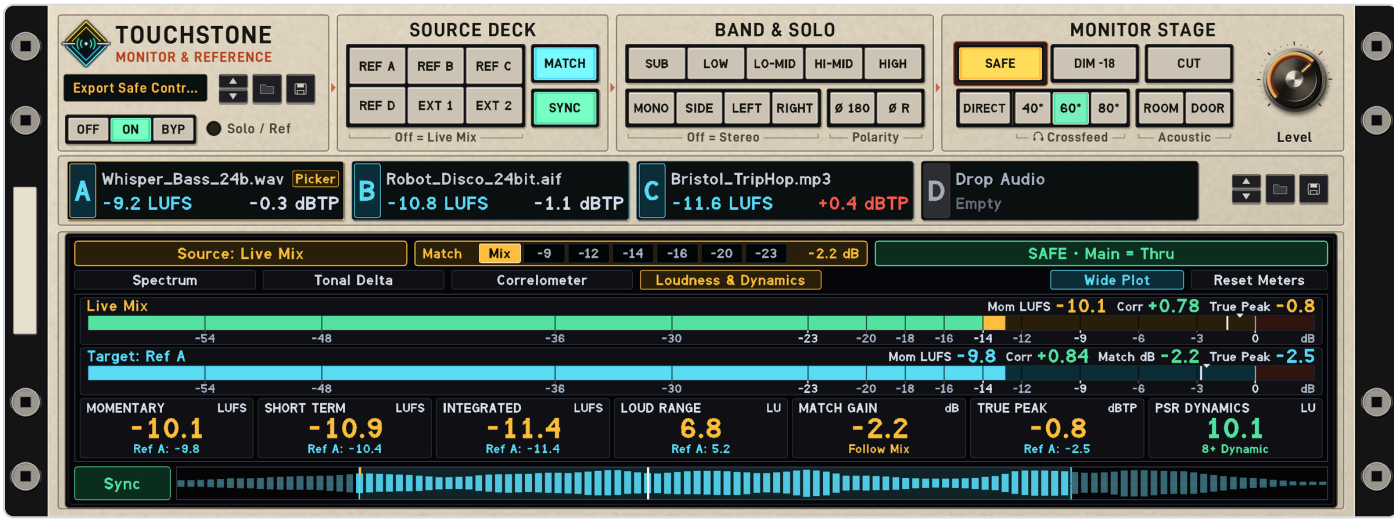

Figure 6: Loudness & Dynamics Wide Plot (Twin Mix/Ref Lanes & 7 LPM Readout Cards)

4. Rear Audio Bus Matrix & Control Room CV (21 Jacks)

Flip the rack (`Tab`) for 18 audio jacks (4 stereo inputs over 5 independent stereo outputs) plus 3 Control Room CV jacks and an on-panel wiring guide.



Figure 7: Touchstone 4U Rear Patchbay (18 Audio Jacks & 3 Control Room CV Jacks)

4.1 Stereo Audio Inputs (Top Row, 8 Jacks)

- **`MAIN MIX IN (L/R)`** (**`Auto-Routed`**): Primary mix input feeding `SAFE` passthrough, `Main Thru` , Mix metering, and (whenever `Ctrl Room In` is unpatched) the `Live Mix` monitor path.
- **`CTRL ROOM IN (L/R)`** (**`Console CR`**): Optional input from Reason Master Section `Ctrl Room Out` for standalone post-master setups, complete with a top-right red loop-fault LED.
- **`EXT REF 1 (L/R)`** & **`EXT REF 2 (L/R)`** (**`Stereo In`**): Live stereo reference inputs for stems, rough mixes, or alternate mastering chains, metered continuously for BS.1770-4 loudness matching.

4.2 Independent Stereo Audio Outputs (Bottom Row, 10 Jacks)

- **`MAIN OUT (L/R)`** (**`Safe On = Thru`**): Auto-routed primary output; locks to a bit-for-bit copy of `Main Mix In` whenever `SAFE` is on.
- **`MAIN THRU (L/R)`** (**`Always Clean`**): Permanent 1:1 clean copy of `Main Mix In` , unaffected by every monitor control.
- **`MONITOR OUT (L/R)`** (**`Phones / Xfeed`**): Dedicated un-bounced headphone or studio monitor output for Hardware Audio Out 3/4. Carries your full control room chain while `SAFE` protects `Main Out` , and receives isolated Crossfeed when both outputs are patched.
- **`SCOPE OUT (L/R)`** (**`Pre-Level • Dry`**): Unity 0.0 dB tap taken after Source, Band Solo, Polarity, and Channel Matrix (strictly before Crossfeed, Room/Door, Dim, Cut, Level, and Fuse) for feeding external spectrum and phase meters.
- **`REF OUT (L/R)`** (**`Sync • Matched`**): Continuous DAW-synced, loudness-matched stream of your active target reference (`Ref A` through `Ref D` or `Ext 1/2`), sleeping at 0% CPU when unpatched on `Live Mix` .

4.3 Standalone Dual-Bus SSL `Ctrl Room In` Behavior

When wired standalone between Reason's **Master Section** (`Master Out` to `Main Mix In` , `Ctrl Room Out` to `Ctrl Room In`) and **Hardware Interface**:

1. **Locked Mix Anchor**: `Main Mix In` keeps `SAFE` passthrough, `Main Thru`, Mix LUFS/True Peak, and the Mix RTA anchored to your true print bus.
2. **Automatic SSL `Ctrl Room` Volume Tracking**: Turn Reason's SSL `Ctrl Room` knob down and Touchstone scales `Ref A` through `Ref D` and `Ext 1/2` by the exact same gain so switching to a reference never jumps in volume (holding that level across transport stops).
3. **Solo & Cue Gain Freeze (`Source: CR Cue / Solo`)**: Press Solo (`PFL` / `AFL`) on any mixer channel or audition an FX return and the CRT header switches to green `Source: CR Cue / Solo`, freezing the tracked reference gain so soloing a quiet stem never pulls your reference level down.
4. **Accidental Loop Protection**: If `Ctrl Room In` is accidentally patched into a dead feedback loop inside a Master Insert, Touchstone ignores the silent loop so your audio stays live, and lights the red fault LED inside the rear `CTRL ROOM IN` jack box.

4.4 Control Room CV Matrix (3 Jacks)

- **`SOURCE` (`0 to 1V Select` CV In)**: Stepped unipolar CV selecting `Live Mix` (0) through `Ext 2` (6) for hardware controller buttons or blind A/B testing.
- **`BINAURAL` (`Gate In` CV In)**: Gate ≥ 0.5 engages Headphone Crossfeed momentarily without changing your saved patch state.
- **`REF ACT` (`Gate Out` CV Out)**: Outputs 1.0 whenever monitoring `Ref A` through `Ext 2`, and 0.0 on `Live Mix`.

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5. Studio Routing & Rack Integration Recipes

Recipe 1: Live EQ Matching with Solstice (`Ref Out` -> Solstice `Ref In`)

Pair Touchstone with **Solstice** right inside your Master Section to match EQ curves against any loaded reference track without extra splitters:

1. Place **Solstice** in the insert slot directly *above* **Touchstone**, and load your commercial reference into Touchstone **Cartridge** `A` with `MATCH` on.
2. Flip the rack (`Tab`) and patch Touchstone `REF OUT L/R` into Solstice `REF IN L/R`.
3. Keep Touchstone on `Live Mix` so you hear your own mix changes live. Open `[EQ Match]` in Solstice and select `Ref In`: Touchstone continuously feeds your DAW-synced, loudness-matched reference track straight into Solstice's profiler.

Recipe 2: Feeding External Analyzers Dry While Mixing on Headphones (`Scope Out`)

If you run external meters (such as Spyglass) downstream of Touchstone while mixing on headphones with `60°` Crossfeed, `ROOM`, and `DIM −18` active, don't feed them from `Monitor Out` (which would skew phase and level meters with headphone crossfeed and dim attenuation). Patch `SCOPE OUT L/R` to your external analyzers instead: they'll follow your A/B source switches, 5-band solos, and mono/polarity checks at a clean, dry 0.0 dB unity level.

Recipe 3: Blind Reference Shootouts via Combinator 2 (`Source` CV)

To test whether your mix holds up without visual bias from knowing which track is playing:

1. Wrap Touchstone and a **Pulsar** LFO (or **Thor** step sequencer) inside a Combinator 2, or map a hardware controller pad to `SOURCE` CV.
2. Patch a stepped random Sample & Hold CV (scaled between 0.0V and 0.35V to step between `Live Mix` and `Ref A` / `Ref B`) into Touchstone's rear `SOURCE` CV input, fold Touchstone to 1U (or scroll away), and adjust your mix bus EQ purely by ear.

6. Factory Preset Reference (8 `.repatch` Patches)

#	Preset File (`Resources/Public/`)	Key Configuration	Recommended Use
1	`Default.repatch`	`Live Mix` , `Match` On (`Follow Mix`), `DAW Sync` , Full Range, Stereo, `DIRECT` , Dry, `SAFE` Off, `Level` 0.0 dB	Clean Master Section insert starting point
2	`Export Safe Control Room (Phones Out 3–4).repatch`	`SAFE` **On**, **60°** Crossfeed **On**, `Match` On	Permanent 4-output rig (`Main Out` to 1/2, `Monitor Out` to 3/4)
3	`60 deg Equilateral Headphone Studio.repatch`	**60°** Crossfeed **On**, `Match` On, `SAFE` Off	Everyday studio headphone mixing on a 2-output rig
4	`40 deg Nearfield Desk Check.repatch`	**40°** Crossfeed **On**, `Match` On, `SAFE` Off	Tight desktop nearfield phantom-center check
5	`80 deg Wide Mains Check.repatch`	**80°** Crossfeed **On**, `Match` On, `SAFE` Off	Wide mains stereo spread and reverb tail check
6	`Sub and Low-End Translation (Sub 60 Hz).repatch`	`Band Solo` = `SUB` (below 60 Hz), `Match` On	Comparing kick and 808 sub weight against a reference
7	`Midrange Vocal and Snare Focus (250 Hz – 4 kHz).repatch`	`Band Solo` = `LO–MID + HI–MID` (250 Hz to 4.5 kHz), `Match` On	Checking vocal presence, snare body, and midrange balance
8	`Mono Compatibility and Phase Check.repatch`	`Channel Mode` = `MONO` , `Match` On	Fast mono-collapse check for bass, leads, and stereo FX

7. MIDI CC, Reason Remote & Combinator 2 Reference

7.1 MIDI Implementation Chart

MIDI CC	Control	Range / Behavior
CC 7	Monitor Level	-24.0 to +12.0 dB (0.0 dB at ~67%)
CC 12	Monitor Source	7 steps: `Live Mix` , `Ref A` through `Ref D` , `Ext 1` , `Ext 2`
CC 13	LUFS Loudness Match	Off / On
CC 14	Frequency Band Solo	32 steps (0 to 31 additive 5-band combinations)
CC 15	Channel Solo Mode	5 steps: `Stereo` , `Mono` , `Sides` , `Left` , `Right`
CC 16	Headphone Crossfeed	Off / On
CC 17	Crossfeed Speaker Angle	3 steps: `40°` , `60°` , `80°`
CC 18	Monitor Dim (-18 dB)	Off / On
CC 19	Export Safe	Off / On

MIDI CC	Control	Range / Behavior
CC 20	Reference Cue Position	0.0% to 100.0% waveform offset

7.2 Reason Remote & Combinator 2 Mapping Table

Remote Internal Name	Short / Tiny	Type & Range
`Monitor Source`	`Source` / `Src`	7 steps (`Live Mix` , `Ref A` through `Ref D` , `Ext 1` , `Ext 2`)
`LUFS Match`	`Match` / `Mtch`	Off / On
`LUFS Match Target`	`Target` / `Tgt`	7 steps (`Follow Mix` , `−9` , `−12` , `−14` , `−16` , `−20` , `−23`)
`Sync Mode`	`Sync` / `Sync`	2 steps (`DAW Sync` / `Cue Loop`)
`Band Solo`	`BandSolo` / `Band`	32 steps (0 to 31 additive 5-band combinations)
`Channel Mode`	`Channel` / `Chan`	5 steps (`Stereo` , `Mono` , `Sides` , `Left` , `Right`)
`Polarity Invert`	`PolInv` / `Pol`	Off / On (`Ø 180°` L+R invert)
`Polarity Right`	`PolRight` / `PolR`	Off / On (`Ø R` Right-only invert)
`Binaural Room`	`Xfeed` / `Xfd`	Off / On (Headphone Crossfeed)
`Speaker Angle`	`Angle` / `Angl`	3 steps (`40°` , `60°` , `80°`)
`Acoustic Environment`	`Acoust` / `Env`	3 steps (`Dry` , `Control Room` , `Studio Door`)
`Monitor Trim`	`Level` / `Lvl`	Continuous -24.0 to +12.0 dB (0.0 dB default)
`Monitor Dim`	`Dim` / `Dim`	Off / On (-18.0 dB pad)
`Monitor Cut`	`Cut` / `Cut`	Off / On (5 ms monitor mute)
`Export Safe`	`Safe` / `Safe`	Off / On (`Main Out` bit-for-bit Thru)
`Cue Position`	`CuePos` / `Cue`	Continuous 0.0% to 100.0%
`CRT View`	`CRTView` / `View`	4 steps (`Spectrum` , `Tonal Delta` , `Correlometer` , `Loudness & Dynamics`)
`CRT Wide`	`WideCRT` / `Wide`	Off / On (`Wide Plot` 7-Card Mode)

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8. Under the Hood & Technical Specifications

8.1 DSP Architecture & Calibration Notes

- **Two-Pass ITU-R BS.1770-4 & EBU Tech 3342 Engine**: Loaded reference files undergo a background two-pass K-weighted scan (-70 LUFS absolute gate, -10 LU relative gate, 0.05 LU histogram bins) alongside 4x Catmull-Rom inter-sample True Peak analysis and 256-bin waveform extraction. Real-time streams (`Main Mix In` and `Ext Ref 1/2`) run 64-bit K-weighted accumulators at a 10 Hz (100 ms) EBU R128 hop rate for Momentary (400 ms), Short-Term (3 s), Integrated LUFS, Loudness Range (`LRA` , 0.10 LU histogram), and `PSR` (`TP − Short`).

- **Resampling, Timeline Lock & Declicking**: Loaded samples stream across 22.05 to 192 kHz via 4-point Catmull-Rom cubic interpolation, locking to Reason's timeline at 15,360 PPQ in `DAW Sync` mode. Mix/Reference source switches use 10 ms equal-power crossfades, while band, channel, and polarity switches bridge steps with an 8 ms raised-cosine declicker.
- **Phase-Aligned 5-Band Linkwitz-Riley Crossover**: Four 4th-order (24 dB/oct) Linkwitz-Riley splits at 60 Hz, 250 Hz, 1.2 kHz, and 4.5 kHz with matched 2nd-order Butterworth all-pass phase compensation reconstruct to **0.00 dB flat magnitude** across all 32 band combinations.
- **Headphone Crossfeed & Closed-Back Acoustic Models**: Crossfeed pairs Woodworth spherical-head fractional interaural time delays (0.176 ms at 40°, 0.261 ms at 60°, and 0.342 ms at 80°) with a 700 Hz contralateral head-shadow low-pass and unity direct-path normalization so mono sub-bass remains calibrated to **0.0 dB**. `ROOM` models an ITU-R BS.1116 treated control room (+8.2 dB direct-to-reverberant ratio, 150 Hz 12 dB/oct bass-trap high-pass keeping sub-60 Hz shifts under 0.12 dB, 4 cross-ear lateral reflection pairs from 5.9 to 25.1 ms, 2-stage Schroeder rear diffuser, and a ~155 ms 2×2 Householder FDN tail within ±0.20 LU). `DOOR` applies 85% Mid / 15% Side pre-summing, 48 Hz to 340 Hz solid-core door mass-law filtering, a 1.1 kHz perimeter seal roll-off, and a 3-tap asymmetric corridor slap.
- **SSL `Ctrl Room` Gain Estimator & Ear-Saver Fuse**: Dual-bus `Ctrl Room In` tracking runs a closed-form least-squares gain estimator gated on stereo cross-correlation ($r \geq 0.99$), freezing gain whenever solo/cue divergence drops correlation below 0.98. The Ear-Saver Fuse clamps non-finite samples, DC offsets (≥ 0.35), and peaks above +6.02 dBFS while keeping signals below threshold bit-exact.

8.2 Technical Specifications Summary

Specification	Details
Product Identifier	`ca.boraas.Touchstone` (Version 1.0.1)
Format	4U Full-Width Studio Effect + Active 1U Folded Rack Strip
Internal Precision & Sample Rates	64-bit internal filter and loudness accumulators, 32-bit float I/O, 22.05 to 192 kHz
Audio Latency	0 samples on `Main Out` (`SAFE` On / flat Mix) and `Main Thru` (zero host PDC)
Reference Deck	4 drag-and-drop MP3, WAV, or AIFF slots + 2 rear stereo External Reference inputs
Loudness Matching	`Follow Mix` or 6 fixed targets (-9, -12, -14, -16, -20, -23 LUFS), -24.0 to +18.0 dB range, -0.3 dBTP peak guard
Band & Channel Matrix	5-band 24 dB/oct LR4 solo (60 Hz, 250 Hz, 1.2 kHz, 4.5 kHz; 0.00 dB sum) + Stereo, Mono (-6 dB), Side, L, R + `Ø 180°` / `Ø R`
Headphone & Room Sim	40° / 60° / 80° Woodworth ITD Crossfeed (Phones-isolated on dual outputs) + `Control Room` & `Studio Door`
Rear Connectivity (21 Jacks)	8 Audio Inputs (`Main Mix In` , `Ctrl Room In` , `Ext Ref 1/2`), 10 Audio Outputs (`Main Out` , `Main Thru` , `Monitor Out` , `Scope Out` , `Ref Out`), 3 CV Jacks (`Source` In, `Binaural` Gate In, `Ref Act` Gate Out)
System Requirements	Reason 10.1 or later (macOS Universal Apple Silicon/Intel & Windows 64-bit, Standalone & Reason Rack Plugin)