Hyperbar 3-Band Upward/Downward Dynamics: Operation Manual & Studio Reference Guide

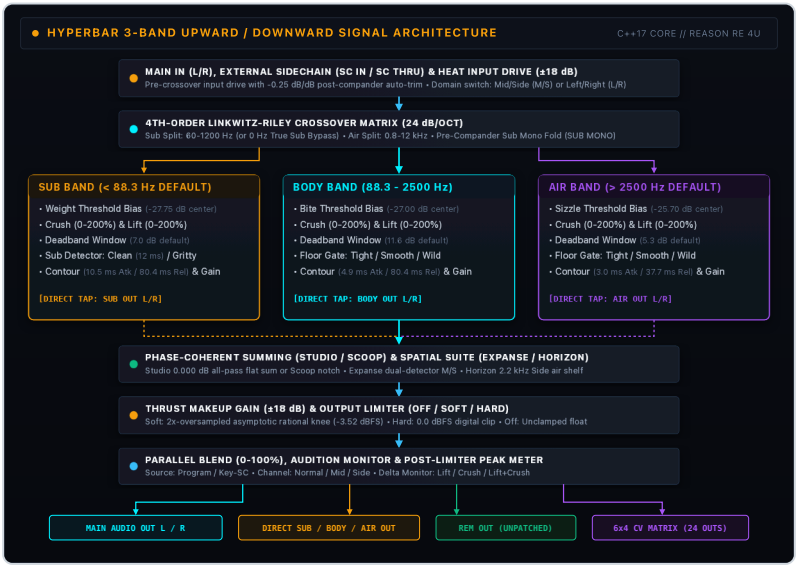
Product Identifier: `ca.boraas.Hyperbar`
Build Version: `1.0.3f149`
Device Classification: Creative Effects / Dynamics (`Dynamics` , `Filter` , `EQ` , `Multiband` , `Mastering`)
Rack Format: 4U Full-Width (collapsible to active compact folded strip)
Supported Platforms: Reason 10.1+ (macOS Intel & Apple Silicon Universal, Windows 64-bit)
Author: Edward Boraas

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1. Overview & Signal Flow

Hyperbar is a 3-band upward and downward dynamics processor (OTT-style multiband compander) built natively for the Reason Rack.

While a standard compressor only turns loud peaks down once they cross a threshold, Hyperbar works in both directions at once across three frequency bands (`SUB` , `BODY` , and `AIR`). It pulls quiet room decay, reverb tails, and low-level harmonic detail upward by up to +36 dB while clamping loud peaks downward by up to -24 dB (-48 dB at 200% overpressure). Between those two thresholds sits a configurable linear **Deadband** (0-48 dB) where mid-level dynamics pass at unity (1:1) without constant gain riding.



Hyperbar 3-Band Upward/Downward Signal Architecture

The Character Switches (Clean Mastering or Classic OTT Grit)

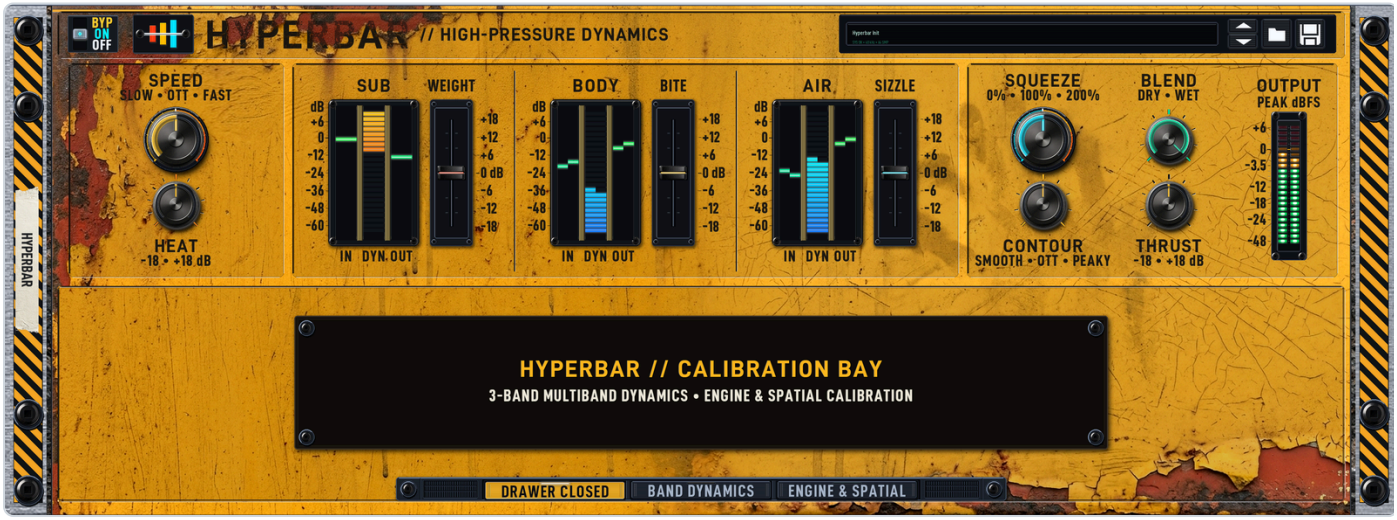
Classic digital OTT processors from the 2000s owe part of their signature sound to early DSP quirks: phase-cancellation notches at the crossover points, sub-bass waveform tracking distortion, and noise-floor hiss surging upward during pauses. Instead of locking you into either a clinical cleanup or permanent artifacts, Hyperbar puts three switches in the **Engine & Spatial** drawer so you can choose per patch:

1. **`X-OVER ( SCOOP | STUDIO )`**: `Studio` mode adds a 2nd-order all-pass phase-compensation network so the three bands sum completely flat (±0.000 dB). `Scoop` mode omits the all-pass stage, bringing back the classic crossover phase notch for a hollow, mid-scooped bite.

2. **`SUB DET` (`GRITTY | CLEAN`)**: `Clean` mode uses a 12 ms anti-ripple peak-hold detector so deep 808s and sine subs stay smooth. `Gritty` mode tracks sub waveforms instantaneously, adding fast envelope-ripple harmonic saturation.
3. **`FLOOR` (`WILD | SMOOTH | TIGHT`)**: A 3-way switch setting the upward expansion noise-floor gate:
   - **`Tight`** (-55 to -67 dBFS, 12 dB soft knee): Clamps tightly for speech, vocals, and noisy stems.
   - **`Smooth`** (default, -62 to -80 dBFS, 18 dB progressive knee): Clean mix and master bus leveling without audible noise pumping.
   - **`Wild`** (-75 to -95 dBFS, 20 dB wide knee): Pulls quiet signals all the way down to -75 dBFS upward so long reverb tails and room tone bloom between notes.

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2. Front-Panel Guided Tour (4U Upper Deck)



Front Panel (4U Upper Macro Deck & Sight-Glass Metering)

Hyperbar's 4U front panel divides controls into two layers: the upper deck holds the macro controls and 3-band sight-glass meters for everyday mixing, while the lower **Calibration Drawer** tucks per-band depths, crossovers, and stereo imaging behind two expandable tabs (`BAND DYNAMICS` and `ENGINE & SPATIAL` , saved with your Reason song across patch changes). All primary gain (`Heat` , `Thrust` , per-band `Gain` , and band threshold faders), depth (`Squeeze` , per-band `Crush` and `Lift`), and `Speed` controls use non-linear S-curves that give you roughly 1.5x-2.2x finer resolution in the 10-to-2 o'clock sweet spot while still reaching full range at the extremes.

2.1 Header Bar

- **`BYP / ON / OFF` Switch**: 3-state power and bypass switch (clicking anywhere on the switchplate or labels toggles state).
- **Patch Browser**: Recessed LCD readout with previous/next (`▲` / `▼`), folder browser, and save buttons for navigating all 39 factory patches.

2.2 Bay 1: Pre / Tone Shaping & Timing (`SPEED` & `HEAT`)

- **`SPEED` (`0.73–18.4` , default `3.67` : `SLOW • OTT • FAST`)**: Scales attack and release speed across all three bands together from 0.20x to 5.0x (a 25:1 range). At `3.67` (12 o'clock), envelope time constants sit at calibrated OTT baseline timing (Sub: 10.47 ms Atk / 80.44 ms Rel; Body: 4.91 ms Atk / 80.44 ms Rel; Air: 2.96 ms Atk / 37.65 ms Rel). Turn counter-clockwise toward `0.73` (`SLOW`) to slow envelopes up to 5x for smooth bus leveling or

sustained reverb tails; turn clockwise toward `18.4` (`FAST`) to speed up attack and release up to 5x for fast rhythmic pumping.

- **`HEAT` (`-18.0 to +18.0 dB` , default `0.0 dB` : `-18 • +18 dB`)**: Pre-crossover input drive into the 3-band compander. Pushing `Heat` up drives all three bands harder into downward `Crush` while pulling quiet details out of upward `Lift` . To prevent runaway volume jumps while you dial in drive, positive `Heat` automatically applies a -0.25 dB/dB post-compander trim (up to -4.5 dB at +18 dB).

2.3 Bay 2: 3-Band Sight-Glass Dynamics Core (`SUB` , `BODY` , `AIR`)

Each of the three bands pairs a three-track **Sight-Glass Meter** (+6 dB down to -60 dB) with a vertical threshold bias fader:

- **Sight-Glass Meter Tracks (`IN` , `DYN` , `OUT`)**:
  - `IN` **(Left)**: Pre-dynamics band input level (`L/R` or `M/S`).
  - `DYN` **(Center)**: Bidirectional dynamics activity from the center zero line. Amber/orange bars descend from the top to show downward gain reduction (`Crush`), while cyan bars rise from the bottom to show upward expansion (`Lift`).
  - `OUT` **(Right)**: Post-dynamics, post-gain band output level.
- **Vertical Threshold Bias Faders (`WEIGHT` , `BITE` , `SIZZLE` , `-18.0 to +18.0 dB` , default `0.0 dB`)**:
  - Shifts both the upward and downward thresholds for that band together around pink-noise-calibrated baseline centers (-27.75 dB Sub, -27.00 dB Body, -25.70 dB Air).
  - Raising `WEIGHT` (`Sub`), `BITE` (`Body`), or `SIZZLE` (`Air`) raises the band's target window, pulling more low-level energy upward; lowering the fader pushes the band deeper into downward `Crush` .

2.4 Bay 3: Master Stage (2x2 Output Grid & Post-Limiter Metering)

Organized into a 2x2 rotary grid alongside stereo output peak meters:

- **`SQUEEZE` (`0–200%` , default `100%` : `0% • 100% • 200%`)**: Global compander depth macro scaling both upward `Lift` and downward `Crush` depths across all three bands simultaneously. From 0-100% (cyan halo), ratios scale up to classic OTT levels; pushing from 100-200% (amber-orange halo) enters overpressure mode, driving downward compression past ∞:1 into negative ratios (at 114.3%, around 2 o'clock) and doubling upward lift range.
- **`CONTOUR` (`SMOOTH • OTT • PEAKY` , `-100% to +100%` , default `0%` , MIDI CC 72)**: Master ballistics contour dial positioned directly beneath `SQUEEZE` . Offsets the attack-to-release ratios across all three bands simultaneously without opening the drawer. Center (`0%` , 12 o'clock) preserves individual band contours; turning counter-clockwise toward `SMOOTH` (-100%) speeds up attack and extends release for dense, pinned sustain; turning clockwise toward `PEAKY` (+100%) slows attack and speeds up recovery for punchy transient crack.
- **`BLEND` (`0–100%` , default `100%` : `DRY • WET`)**: Parallel dry/wet mix before the final output peak meters.
- **`THRUST` (`-18.0 to +18.0 dB` , default `0.0 dB` : `-18 • +18 dB`)**: Master post-compander makeup gain feeding the output limiter stage.
- **Stereo `OUTPUT PEAK dBFS` Meters (`L` / `R` , `+6 to -48 dBFS`)**: True post-limiter stereo peak bar meters:
  - `0.0 dBFS` **Calibration**: `0.0 dBFS` lights up to the top amber LED (segment 18, right under the golden `0 dB` line), while levels strictly above `0.0 dBFS` (+0.1 to +6.0 dBFS) light the 4 red Overpressure LEDs at the top of the ladder.
  - **Quick Clipper Check (MClass Maximizer Workflow)**: Because `Soft` and `Hard` limiter modes clamp output peaks at or below `0.0 dBFS` , the meter snaps cleanly to the `0 dB` line when limiting is active. Flip `Limiter` to `Off` in the drawer to watch how many red LEDs light up above `0 dB` and judge how hard you're driving the clipper.

2.5 Compact Folded Strip



Compact Folded Rack Strip

When folded in the Reason rack, Hyperbar keeps its header controls (`BYP/ON/OFF` and Patch Browser) at identical coordinates and exposes a compact control strip mirroring the 4U left/center/right layout:

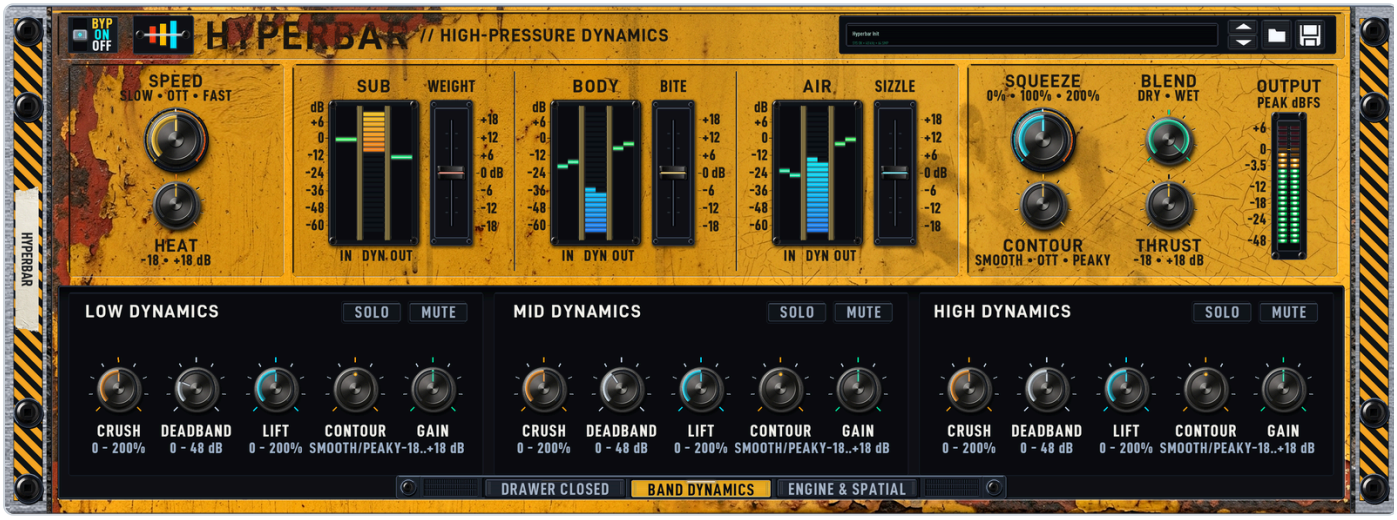
- **Left**: `SPEED` and `HEAT` input drive dials.
- **Center**: Vertical `SUB` , `BODY` , and `AIR` bidirectional dynamics activity meters.
- **Right**: `SQUEEZE` , `BLEND` , `CONTOUR` , `THRUST` , and stereo `OUT` peak meters.

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3. The Calibration Drawer (`Band Dynamics` & `Engine & Spatial`)

Clicking the tabs along the bottom rail of the upper deck switches the lower bay between two open views (`BAND DYNAMICS` and `ENGINE & SPATIAL`). Clicking whichever tab is currently open (or clicking `DRAWER CLOSED`) closes the drawer. Because the drawer state is saved with your Reason song rather than per preset, switching or browsing patches never resets your open view.

3.1 Tab 1: `BAND DYNAMICS` (Per-Band Voicing)



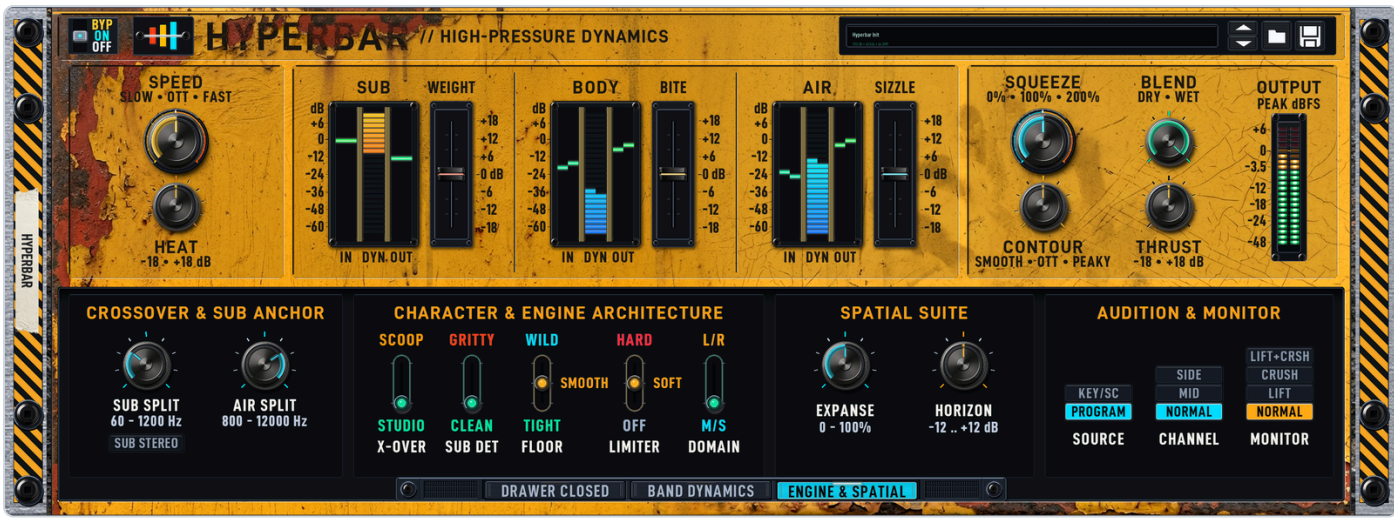
Calibration Drawer — Tab 1: Band Dynamics

Exposes three side-by-side band bays (`LOW DYNAMICS` for Sub, `MID DYNAMICS` for Body, `HIGH DYNAMICS` for Air), each equipped with `SOLO` and `MUTE` buttons and five rotary trims:

- `SOLO` & `MUTE` **Buttons**: Audition any band (or combination of bands) in isolation, or mute specific frequency ranges.
- `CRUSH` **(** `0–200%` **, default** `100%` **)**: Scales downward compression depth for the band (multiplied by the master `Squeeze` macro).

- **`DEADBAND` (`0.0–48.0 dB` , defaults: `7.0 dB` Sub, `11.6 dB` Body, `5.3 dB` Air)**: Sets the width of the neutral 1:1 linear zone between the downward `Crush` threshold and upward `Lift` threshold, defaulting to classic OTT `Above – Below` threshold gaps (`7.0 / 11.6 / 5.3 dB`). Tightening `Deadband` toward 0 dB clamps the signal into a tight window; widening it opens a natural pocket where mid-level transients breathe untouched.
- **`LIFT` (`0–200%` , default `100%`)**: Scales upward compression depth for the band (up to +36.0 dB maximum boost).
- **`CONTOUR` (`SMOOTH/PEAKY` , default `0.50`)**: Skews the band's attack-to-release ratio across a 9x span (0.33x-3.0x):
  - **Smooth (`0.0` , 0.33x)**: Faster attack and longer release for thick, pinned weight.
  - **OTT Center (`0.50` , 1.0x)**: Calibrated OTT baseline ratios (Sub: 10.47 ms Atk / 80.44 ms Rel [1:7.7]; Body: 4.91 ms Atk / 80.44 ms Rel [1:16.4]; Air: 2.96 ms Atk / 37.65 ms Rel [1:12.7]).
  - **Peaky (`1.0` , 3.0x)**: Slower attack and faster release so initial drum and pluck transients punch through before compression clamps down.
- **`GAIN` (`-18.0 to +18.0 dB` , default `0.0 dB`)**: Post-compander makeup gain for balancing the three bands before summing.

3.2 Tab 2: `ENGINE & SPATIAL` (Crossovers, Character, Stereo & Audition)



Calibration Drawer — Tab 2: Engine & Spatial

Divided into four functional sub-bays across the lower drawer:

Bay 1: Crossover & Sub Anchor

- **`SUB SPLIT` (`Bypass` / `60–1200 Hz` , default `88.3 Hz`)**: Sets the 4th-order Linkwitz-Riley crossover frequency between `Sub` and `Body` . Turning `Sub Split` all the way counter-clockwise below 61 Hz (`Bypass`) engages a true 0 Hz Sub Bypass so `Body` and `Air` operate as a phase-coherent 2-band split down to DC.
- **`AIR SPLIT` (`800–12000 Hz` , default `2.50 kHz`)**: Sets the 4th-order Linkwitz-Riley crossover frequency between `Body` and `Air` . If `Sub Split` is pushed above `Air Split` , Hyperbar automatically clamps the upper split at least 200 Hz above `Sub Split` so the `Body` bandpass never inverts.
- **`SUB STEREO` / `SUB MONO` Toggle Button**: Folds the `Sub` band to mono **before** the compander and before the rear-panel `SUB OUT` jack, keeping bass phase-solid across both main and direct outputs.

Bay 2: Character & Engine Architecture

- **`X-OVER` (`SCOOP | STUDIO` , default `STUDIO`)**: Selects classic phase-notched crossover summing (`Scoop`) or phase-compensated all-pass flat summing (`Studio`).
- **`SUB DET` (`GRITTY | CLEAN` , default `CLEAN`)**: Selects instantaneous sub peak tracking (`Gritty`) or 12 ms anti-ripple hold (`Clean`).
- **`FLOOR` (`WILD | SMOOTH | TIGHT` , default `SMOOTH`)**: 3-way switch selecting `Tight` (-55 to -67 dBFS, 12 dB knee), `Smooth` (-62 to -80 dBFS, 18 dB progressive knee, default), or `Wild` (-75 to -95 dBFS, 20 dB wide knee) upward expansion floor.
- **`LIMITER` (`HARD | SOFT | OFF` , default `SOFT`)**:
  - **`OFF`** : Unclamped floating-point output for external mastering chains (allowing the output meter's 4 red LEDs above 0.0 dBFS to display peak excursion).
  - **`SOFT`** : 2x-oversampled (at sample rates < 88.2 kHz) continuous soft knee starting at -3.52 dBFS (2/3 linear) and approaching 0.0 dBFS asymptotically without a hard clip corner.
  - **`HARD`** : Zero-oversampled digital brickwall clip at ±1.0 (0.0 dBFS) for intentional digital crunch.
- **`DOMAIN` (`L/R | M/S` , default `M/S`)**: Selects Left/Right or Mid/Side stereo signal processing across the 3-band compander.

Bay 3: Spatial Suite

- **`EXPANSE` (`0–100%` , default `0%`)**: Blends the 3-band detectors from 100% stereo-linked (`0%`) to independent dual-detector Mid/Side (or Left/Right) operation (`100%`). Raising `Expanse` lets upward `Lift` pull stereo room width and wide synth chorusing up on the Side channel whenever center vocal or snare hits subside.
- **`HORIZON` (`–12.0 to +12.0 dB` , default `0.0 dB`)**: Post-dynamics stereo **Side** width trim paired with a 2nd-order high-shelf filter (2.2 kHz corner) on the stereo Side channel, active in both `M/S` and `L/R` Domain modes. Positive `Horizon` boosts widen `Body` and `Air` while clamping `Sub` Side boost at ≤ 0 dB so sub-bass stays phase-coherent; negative `Horizon` cuts narrow the stereo image across all bands.

Bay 4: Audition & Monitor

- **`SOURCE` (`KEY/SC | PROGRAM` , default `PROGRAM`)**: Switches the main output monitor between processed program audio and the post- `Heat` detector signal (`Key/SC` , either external `SC IN` when patched or internal key) unaffected by `Blend` or `Thrust` , so you can solo and tune crossover splits while dialing in frequency-dependent ducking.
- **`CHANNEL` (`SIDE | MID | NORMAL` , default `NORMAL`)**: Solos the stereo `Mid` sum or `Side` difference at the output stage.
- **`MONITOR` (`LIFT+CRUSH | CRUSH | LIFT | NORMAL` , default `NORMAL`)**: Solos the delta difference signal (`wet − dry`) for upward expansion (`Lift`), downward compression (`Crush`), or both combined (`Lift+Crush`) so you can hear what the compander is adding or removing.

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4. Rear-Panel Modular Connectivity & Audio/CV Matrix



Rear Panel — Audio Routing, CV Modulation Inputs & 6x4 CV Telemetry Matrix

Flip the rack (`Tab`) to access Hyperbar's 4U rear panel: 16 audio jacks, 14 CV modulation inputs with bipolar attenuverters, and a 24-jack (`6x4`) CV telemetry matrix.

4.1 16 Audio Jacks & Dynamic Remainder Bus

- **`MAIN IN (L/R)`** & **`MAIN OUT (L/R)`**: Primary stereo insert path (mono cables on `L` automatically normal to both channels).
- **`SC IN (L/R)`** & **`SC THRU (L/R)`**: External key input routed through its own matched 4th-order Linkwitz-Riley crossover so external triggers duck each band only where the key signal carries energy (for example, an 808 kick ducking `Sub` while leaving `Body` and `Air` untouched). `SC THRU` copies the incoming key signal directly to downstream devices with zero latency.
- **Direct Band Outputs (`SUB OUT` , `BODY OUT` , `AIR OUT`)**: Discrete stereo outputs tapped after each band's compander and band gain stage.
- **`REM OUT (L/R)` (Dynamic Remainder Bus)**:
  - Automatically sums whichever bands aren't patched at the direct band outputs, and applies the `Horizon` Side-air shelf whenever the `Air` band remains part of the unpatched residual sum.
  - Patching a cable into `SUB OUT` routes `Sub` to your external bass chain while `REM OUT` automatically carries `Body + Air` (with `MAIN OUT` continuing to carry the full 3-band sum).

4.2 14 CV Modulation Inputs (with Bipolar Attenuverters ±100%)

Every CV input includes a dedicated bipolar trim pot (`-100% to +100%` , center `0%`):

- **Master & Crossover Row (6)**: `HEAT` , `SPEED` , `SQUEEZE` , `BLEND` , `SUB XO` , `AIR XO` .
- **Per-Band Crush & Lift Row (6)**: `SUB` , `BODY` , `AIR` (`CRUSH`) and `SUB` , `BODY` , `AIR` (`LIFT`).
- **Spatial Sub-Bay (2)**: `EXPANSE` and `HORIZON` .

4.3 24-Jack `6x4` CV Telemetry Matrix

Outputs unipolar control voltages (`0.0–1.0` in Reason CV space, smoothed via a 200 Hz one-pole lowpass filter to prevent control-rate zipper noise) across six rows (**`SUB`** , **`BODY`** , **`AIR`** , stereo **`MID`** , stereo **`SIDE`** , and **`ALL`**) and four telemetry columns:

- `ENV` **Column**: Post-dynamics band/channel amplitude envelope (`0 dBFS = 1.0`).
- `CRSH` **Column**: Active downward gain reduction intensity (`24 dB reduction = 1.0`).
- `LIFT` **Column**: Active upward expansion lift intensity (`36 dB boost = 1.0`).
- `TRIG` **Column**: Instantaneous transient gate pulse (`1.0` on sharp rhythmic attacks exceeding +4.5 dB crest differential, with a 20 ms minimum hold time).

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5. Mathematical Reference & DSP Architecture

For engineers who want the exact numbers behind the faceplate: Hyperbar is written in standard ISO C++17 (`dsp/`) with zero host SDK dependencies in the signal path, running 64-bit double-precision state variables inside the crossover filters and 32-bit IEEE-754 floating-point audio buffers.

5.1 4th-Order Linkwitz-Riley Crossovers (24 dB/octave)

Each split point cascades two 2nd-order Butterworth biquad sections ($Q = 1/\sqrt{(2)} \approx 0.7071$) to form a 4th-order Linkwitz-Riley (LR4) filter pair whose lowpass and highpass power responses sum to unity ($0.0\ dB$) at f_c:

$$|H_{LP}(j\omega)|^2 + |H_{HP}(j\omega)|^2 = 1$$

In `Studio` crossover mode, a matched 2nd-order all-pass filter is inserted on the lower path to align group delay across the upper split (f_{High}), yielding $\pm\ 0.000\ dB$ magnitude flatness across $20\ Hz–20\ kHz$ when all bands are at unity.

In `Scoop` mode, the phase-alignment all-pass is bypassed to preserve the vintage 3-band phase-cancellation notch.

5.2 Dual-Threshold Compander & Adjustable Deadband

For each band $k \in \{Low, Mid, High\}$, the downward threshold $T_{down,k}$ and upward threshold $T_{up,k}$ are separated by the user-configurable `Deadband` width $\Delta_{DB,k} \in [0, 48]\ dB$ and shifted by the front-panel threshold bias fader $B_k \in [-18, +18]\ dB$:

$$T_{down,k} = T_{0,k} - B_k + 0.5 \cdot \Delta_{DB,k}, \quad T_{up,k} = T_{0,k} - B_k - 0.5 \cdot \Delta_{DB,k}$$

Baseline threshold centers $T_{0,k}$ are calibrated for equal downward gain reduction on pink noise ($-3\ dB/octave$):

- `SUB` (`Low`): Center $T_{0,Low} = -27.75\ dB$, Deadband $\Delta_{DB,Low} = 7.0\ dB$ (Downward $T_{down} = -24.25\ dB$, Upward $T_{up} = -31.25\ dB$)
- `BODY` (`Mid`): Center $T_{0,Mid} = -27.00\ dB$, Deadband $\Delta_{DB,Mid} = 11.6\ dB$ (Downward $T_{down} = -21.20\ dB$, Upward $T_{up} = -32.80\ dB$)
- `AIR` (`High`): Center $T_{0,High} = -25.70\ dB$, Deadband $\Delta_{DB,High} = 5.3\ dB$ (Downward $T_{down} = -23.05\ dB$, Upward $T_{up} = -28.35\ dB$)

Given the smoothed log-domain detector envelope $E_{dB,k}[n]$:

- **Downward Compression (`Crush` , $E_{dB,k}[n] > T_{down,k}$)**:

$$G_{down,k}[n] = -\min(48.0, D_{down,k} \cdot S \cdot (E_{dB,k}[n] - T_{down,k}) \cdot (1 - (1)/(R_{down})))$$

- **Upward Compression (`Lift` , $E_{dB,k}[n] < T_{up,k}$)**:

$$G_{up,k}[n] = +\min(36.0, D_{up,k} \cdot S \cdot w_{gate}(E_{dB,k}[n]) \cdot (T_{up,k} - E_{dB,k}[n]) \cdot (1 - (1)/(R_{up})))$$

- **Linear Deadband ($T_{up,k} \le E_{dB,k}[n] \le T_{down,k}$)**:

$$G_{down,k}[n] = 0\ \text{dB}, \quad G_{up,k}[n] = 0\ \text{dB}$$

Here $S \in [0, 2]$ is the master `Squeeze` macro. Normalized knob position $v \in [0, 1]$ maps to S via a gentle cubic S-curve centered at nominal 100% ($v = 0.5$, $u = 2v - 1 \in [-1, 1]$):

$$S(u) = 1.0 + 0.45\,u + 0.55\,u^3$$

Because the derivative $dS/du = 0.45 + 1.65\,u^2$ is 0.45 at noon versus 2.10 at the extremes, you get $\sim 2.2\times$ finer resolution across the 10-to-2 o'clock sweet spot. The per-band `Crush` ($D_{down,k}$) and `Lift` ($D_{up,k}$) dials use the identical cubic S-curve, while `Heat`, `Thrust`, per-band `Gain`, and the `Weight / Bite / Sizzle` threshold bias faders use a 1.5-power S-curve ($18.0 \cdot sgn(u) \cdot |u|^{1.5}$) for $\sim 1.5\times$ finer resolution around $0\ dB$. The smoothstep floor weight w_{gate} attenuates upward lift across the selected `Floor` knee: `Tight` (-55 to $-67\ dBFS$, $12\ dB$ knee), `Smooth` (-62 to $-80\ dBFS$, $18\ dB$ knee), or `Wild` (-75 to $-95\ dBFS$, $20\ dB$ knee).

5.3 Ballistics Scaling (`Speed`, Master `Contour` & Per-Band `Contour`)

Given normalized `Speed` input $v_{speed} \in [0, 1]$ and bipolar deflection $u = 2v_{speed} - 1 \in [-1, 1]$, the detent-free cubic S-curve exponent $s(u) = 0.35\,u + 0.65\,u^3$ scales global ballistics by $M_{speed} = 5^{-s(u)} \in [0.20, 5.0]$.

The main-panel Master `CONTOUR` control (normalized $u_{master} \in [0, 1]$, display -100% to $+100\%$ with `SMOOTH • OTT • PEAKY`, default 0.5 / 0%) offsets all three band contours simultaneously:

$$u_{eff,k} = \text{clamp}(u_{contour,k} + (u_{master} - 0.5), 0.0, 1.0)$$

Coupled with per-band `Contour` ratio skew $C_k = 3^{2(u_{eff,k} - 0.5)} \in [0.333, 3.0]$, effective attack and release times scale around the calibrated 1-pole baseline constants ($\tau_{att,0,k}$, $\tau_{rel,0,k}$):

$$\tau_{att,k} = (\tau_{att,0,k})/(M_{speed}) \cdot \sqrt{(C_k)}, \quad \tau_{rel,k} = (\tau_{rel,0,k})/(M_{speed} \cdot \sqrt{(C_k)})$$

Turning `Contour` counter-clockwise toward `SMOOTH` ($C_k < 1$) speeds up attack and extends release across all three bands for sustained thickness; turning clockwise toward `PEAKY` ($C_k > 1$) lengthens attack by up to $\sqrt{(3)}\times$ and shortens release by up to $1/\sqrt{(3)}\times$, shifting the attack-to-release ratio by up to $3.0\times$ so transients punch through cleanly.

5.4 2x-Oversampled Asymptotic Rational Soft Limiter

In `Soft` limiter mode, signals below $88.2\ kHz$ pass through a 2x polyphase half-band oversampler into a C^1-continuous rational saturator with unity slope and bit-exact linear passthrough below the $-3.52\ dBFS$ ($|x| = 2/3$) knee:

$$f(x) = x \quad (|x| \le 2/3), \qquad f(x) = \text{sgn}(x) \cdot ((2)/(3) + (|x| - 2/3)/(1 + 3(|x| - 2/3))) \quad (|x| > 2/3)$$

Unlike a cubic polynomial clipper that flat-tops above $|x| = 4/3$, this rational curve approaches $\pm\,1.0$ ($0.0\ dBFS$) asymptotically as $|x| \to \infty$, preventing hard-inflection foldback distortion on heavy sub-bass peaks.

6. Eight Studio Production Workflows

1. Vocal Glassy Air & Consonant Presence

- **Presets**: `Quick – Vocal Glassy Air` or `04 Vocals & Top End/Hyperpop Vocal Maximizer`
- **Setup**: Insert Hyperbar directly on a lead vocal and dial `Blend` to 35-50%. High-band upward `Lift` pulls breath and consonant air forward, while downward `Crush` clamps harsh sibilance. Raise `Horizon` (+2.0 to +3.0 dB) in the **Engine & Spatial** drawer to widen stereo vocal doubles around a solid center lead.

2. Reese Bass & 808 Sub Sculpting

- **Presets**: `Quick – Bass & 808 Sub Lock`, `02 Drums & Percussion/808 Sub Sculptor`, or `03 Bass & Low End/Reese Bass Squeeze`
- **Setup**: Engage `SUB MONO` so everything below `Sub Split` (140-161 Hz) stays phase-locked in the center. Choose `SUB DET: Clean` for pure, ripple-free sub weight on 808s, or flip to `Gritty` on Reese basses to inject odd-harmonic growl that cuts through on small speakers.

3. Ambient Decay & Reverb Tail Resynthesis

- **Presets**: `Quick – Ambient Reverb Cloud` or `07 Sound Design & FX/Ghostly Reverb Resuscitator`
- **Setup**: Place Hyperbar after a reverb on a sparse pluck, guitar, or piano track, turn `Speed` down toward `Slow` (1.46), and switch `FLOOR` to `Wild`. As notes ring out, upward `Lift` pulls the fading reverb tail up by up to +36 dB, turning quiet room decay into an evolving pad without smearing initial note attacks.

4. Peaky Drum Bus Punch & Transient Snap

- **Presets**: `Quick – Drum Bus Punch & Room` or `Quick – Snare & Clap Shaper`
- **Setup**: Turn the main-panel `Contour` knob clockwise toward `Peaky` (+50% to +75%). Initial kick and snare attacks punch cleanly through the slower attack window before fast release ballistics pull room tone, hi-hat shimmer, and ghost notes upward between hits.

5. Parallel New York / Overpressure Smash

- **Preset**: `07 Sound Design & FX/Parallel Slam`
- **Setup**: Drive `Heat` hot (+6 to +9 dB) with `Squeeze` pushed into overpressure (140-160%) and `Limiter` set to `Soft`, then pull `Blend` back to 25-40%. The dry path preserves your natural uncompressed transients while the wet path tucks a dense floor of low-level sustain underneath.

6. Frequency-Selective Sidechain Ducking (No External Splitters)

- **Setup**: Cable a kick or vocal trigger into rear-panel **`SC IN`**. Open **`ENGINE & SPATIAL`** and switch `SOURCE` to `KEY/SC` to hear the detector signal while tuning `Sub Split` (90-150 Hz). Switch `SOURCE` back to `PROGRAM`, open **`BAND DYNAMICS`**, set Sub `Lift` to 0%, and raise Sub `Crush`: the kick now ducks only the `Sub` band while `Body` and `Air` play continuously without full-band pumping.

7. Multiband Parallel Distortion via **`REM OUT`**

- **Setup**: Patch rear-panel **`SUB OUT`** directly to a clean mixer channel (with `SUB MONO` enabled) and route **`REM OUT`** (`Body + Air`) through Scream 4 or Pulveriser before returning to a second mixer channel. You get phase-aligned multiband splitting and OTT dynamics from a single rack unit without Spider Audio Splitters.

8. Mix Bus Density & Side-Air Polish

- **Presets**: `Quick – Mix Bus Density Lift` or `06 Mix Bus & Mastering/M–S Mastering Expanse`

- **Setup**: Keep `X-OVER` in `Studio` mode for ±0.000 dB phase-compensated summing, dial `Squeeze` down to 10-25%, and add +1.5 dB of `Horizon` and 25% `Expanse`. Quiet reverbs and stereo percussion lift gently into the mix without squashing master crest factor.

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7. Factory Preset Library (39 Presets)

Hyperbar ships with **39 factory `.repatch` presets** (all tagged with Reason 13+ Browser `.rsmeta` metadata): **11 root-level Quick Starters** plus **28 categorized presets** across 7 numbered folders:

7.1 Root Quick Starters (11 Presets)

- `Quick – Modern HyperOTT Slam`: Modern phase-coherent OTT flagship (`Studio` crossover, `M/S` domain, 50% `Expanse`, +1.5 dB `Horizon`, `Sub Mono` On).
- `Quick – Record Transfer (Classic OTT)`: Tribute to classic freeware digital 3-band OTT (`Scoop` crossover, `Gritty` sub, `Wild` floor, 88.3 Hz / 2.50 kHz splits).
- `Quick – Competent City (Original OTT)`: Tribute to the classic DAW-native multiband OTT preset (`Studio` crossover, `Clean` sub detector, `Smooth` floor).
- `Quick – Vocal Glassy Air`: High-band vocal air boost (High `Lift` 200%, +1.8 dB `Sizzle` bias) with mid-band leveling.
- `Quick – Bass & 808 Sub Lock`: Clean sub-bass sustain and mid-growl focus (`Sub Split` 161.2 Hz, `Clean` sub detector, `Sub Mono` On).
- `Quick – Ambient Reverb Cloud`: `Wild`-floor room and acoustic decay extraction (`Speed` 1.46, `Squeeze` 76%).
- `Quick – Snare & Clap Shaper`: Fast-recovery transient crack (`Speed` 14.61, `Peaky` Mid/High Contour).
- `Quick – Drum Bus Punch & Room`: Parallel drum bus glue (`Speed` 2.54, `Squeeze` 30%, `Peaky` Mid/High Contour).
- `Quick – Dynamic HF Air Exciter`: Top-end sheen and de-essing above 4.06 kHz (High `Lift` 200%, High `Crush` 160%).
- `Quick – EDM OTT Master Wall`: Heavy neuro and synth resampling (`Heat` +1.8 dB, `Speed` 7.32, `Scoop / Gritty / Wild`).
- `Quick – Mix Bus Density Lift`: Subtle mastering bus lift (`Squeeze` 10%, `Speed` 1.60, `Studio` flat summing).

7.2 Categorized Subfolders (28 Presets)

- **`01 Factory Essentials` (3)**: `Aggressive Breakbeat Crusher`, `EDM Big Squeeze`, `Gentle Mastering Glue`.
- **`02 Drums & Percussion` (4)**: `808 Sub Sculptor`, `Drum Bus Energizer`, `Hi-Hat Shimmer & Sizzle`, `Snare Crack & Room`.
- **`03 Bass & Low End` (4)**: `Acid Squelch Densifier`, `Reese Bass Squeeze`, `Sub Thump & Low Anchor`, `Zero-Split True Sub Monofier`.
- **`04 Vocals & Top End` (5)**: `De-Breath Vocal Polisher`, `Dual-Mono Vintage Vocal Slam`, `Hyperpop Vocal Maximizer`, `Intimate Whispers & Breaths`, `Vocal Air & Presence`.
- **`05 Synths & Keys` (4)**: `Pluck Resynthesizer`, `Supersaw Wall of Sound`, `SynthClarity – (by noiseShadow)`, `Warm Rhodes Sustain`.
- **`06 Mix Bus & Mastering` (3)**: `Broadcast Density Enhancer`, `M-S Mastering Expanse`, `Transparent Multiband Leveler`.
- **`07 Sound Design & FX` (5)**: `Ghostly Reverb Resuscitator`, `Granular Texture Extractor`, `Parallel Slam`, `Stereo Horizon Diffuser`, `Wild Noise Sifter`.

8. Audio Specifications

Specification	Value / Tolerance
Audio Processing Resolution	64-bit double-precision internal crossover filters; 32-bit IEEE-754 float audio path
Crossover Topology	4th-Order Linkwitz-Riley (24 dB/octave cascaded Butterworth biquads)
Crossover Ranges	`Sub Split`: 60-1200 Hz (< 61 Hz = 0 Hz true sub-bypass); `Air Split`: 800 Hz-12 kHz
Summing Magnitude Flatness	±0.000 dB (20 Hz-20 kHz) in `Studio` mode
Compander Depth Range	`Squeeze`: 0-200% (100% nominal); `Crush` (Downward): 0-200% (to -24 dB, -48 dB at 200%); `Lift` (Upward): 0-200% (to +36 dB)
Threshold Centers & Bias	Pink-noise-matched defaults: `Sub` -27.75 dB, `Body` -27.00 dB, `Air` -25.70 dB (±18 dB bias faders)
Deadband Width Range	0.0-48.0 dB per band (`7.0 / 11.6 / 5.3 dB` OTT defaults)
Ballistics Scaling	`Speed`: 0.73-18.4 (`3.67` noon baseline, 0.20x-5.0x range); Master `Contour`: -100% to +100% (`SMOOTH • OTT • PEAKY`); Per-band `Contour`: 0.33x-3.0x attack/release ratio skew
Gain Stage Range	`Heat`, `Thrust`, and per-band `Gain`: -18.0 to +18.0 dB
Output Limiter Modes	`Off`, `Soft` (2x-oversampled < 88.2 kHz, -3.52 dBFS asymptotic rational knee), `Hard` (0.0 dBFS clip)
Output Peak Metering	Post-limiter stereo peak ladder (+6 to -48 dBFS); `0.0 dBFS` at top amber LED, 4 red Overpressure LEDs above `0.0 dBFS`
Audio Latency	0 samples (zero latency across all modes)
Supported Sample Rates	44.1 kHz to 192.0 kHz
SDK Compatibility	Reason Jukebox SDK 4.6.0 (Reason 10.1+ through Reason 14+)

9. Reason Remote & MIDI CC Implementation Chart

Property Name	Remote Internal Name	MIDI CC	Range / Options	Default
`heat`	`Heat`	CC 13	-18.0 to +18.0 dB	0.0 dB
`speed`	`Speed`	CC 14	0.73-18.4 (0.20x-5.0x)	3.67
`squeeze`	`Squeeze`	CC 15	0-200%	100%
`master_contour`	`Master Contour`	CC 72	-100% to +100% (`SMOOTH • OTT • PEAKY`)	0% (`0.50`)
`thrust`	`Thrust`	CC 16	-18.0 to +18.0 dB	0.0 dB

Property Name	Remote Internal Name	MIDI CC	Range / Options	Default
`blend`	`Blend`	CC 17	0-100%	100%
`limiter_mode`	`Limiter Mode`	--	`Off`, `Soft`, `Hard`	`Soft`
`xover_low_mid`	`X-Over Low/Mid`	CC 21	`Bypass` / 60-1200 Hz	88.3 Hz
`xover_mid_high`	`X-Over Mid/High`	CC 22	800-12000 Hz	2500 Hz
`sub_mono`	`Sub Mono`	--	`Stereo`, `Mono`	`Stereo`
`crossover_mode`	`Crossover Mode`	--	`Studio`, `Scooped`	`Studio`
`sub_detector_mode`	`Sub Detector Mode`	--	`Clean`, `Gritty`	`Clean`
`upward_gate_mode`	`Upward Gate Mode`	--	`Tight`, `Smooth`, `Wild`	`Smooth`
`spatial_domain`	`Spatial Domain`	CC 71	`M/S`, `L/R`	`M/S`
`expanse`	`Expanse`	CC 12	0-100%	0%
`horizon`	`Horizon`	CC 70	-12.0 to +12.0 dB	0.0 dB
`sc_listen`	`Sidechain Listen`	--	`Program`, `Key/SC`	`Program`
`channel_mode`	`Channel Mode`	--	`Normal`, `Mid`, `Side`	`Normal`
`audition_mode`	`Monitor Mode`	--	`Normal`, `Lift`, `Crush`, `Lift+Crush`	`Normal`
`drawer_open`	`Calibration Drawer`	--	`Closed`, `Band Calibration`, `Engine & Spatial`	`Closed`
`low_thresh_bias`	`Low Thresh Bias`	CC 18	-18.0 to +18.0 dB	0.0 dB
`low_upward_depth`	`Low Upward Lift`	CC 23	0-200%	100%
`low_downward_depth`	`Low Downward Crush`	CC 24	0-200%	100%
`low_deadband`	`Low Deadband`	--	0.0-48.0 dB	7.0 dB
`low_contour`	`Low Contour`	--	0.33x-3.0x (`Smooth / OTT / Peaky`)	1:7.7 (`0.50`)
`low_gain`	`Low Band Gain`	CC 25	-18.0 to +18.0 dB	0.0 dB
`low_solo` / `low_mute`	`Low Band Solo` / `Mute`	--	`Off`, `On`	`Off`
`mid_thresh_bias`	`Mid Thresh Bias`	CC 19	-18.0 to +18.0 dB	0.0 dB
`mid_upward_depth`	`Mid Upward Lift`	CC 26	0-200%	100%
`mid_downward_depth`	`Mid Downward Crush`	CC 27	0-200%	100%
`mid_deadband`	`Mid Deadband`	--	0.0-48.0 dB	11.6 dB
`mid_contour`	`Mid Contour`	--	0.33x-3.0x (`Smooth / OTT / Peaky`)	1:16.4 (`0.50`)

Property Name	Remote Internal Name	MIDI CC	Range / Options	Default
`mid_gain`	`Mid Band Gain`	CC 28	-18.0 to +18.0 dB	0.0 dB
`mid_solo` / `mid_mute`	`Mid Band Solo` / `Mute`	--	`Off`, `On`	`Off`
`high_thresh_bias`	`High Thresh Bias`	CC 20	-18.0 to +18.0 dB	0.0 dB
`high_upward_depth`	`High Upward Lift`	CC 29	0-200%	100%
`high_downward_depth`	`High Downward Crush`	CC 30	0-200%	100%
`high_deadband`	`High Deadband`	--	0.0-48.0 dB	5.3 dB
`high_contour`	`High Contour`	--	0.33x-3.0x (`Smooth / OTT / Peaky`)	1:12.7 (`0.50`)
`high_gain`	`High Band Gain`	CC 31	-18.0 to +18.0 dB	0.0 dB
`high_solo` / `high_mute`	`High Band Solo` / `Mute`	--	`Off`, `On`	`Off`

10. External Links & Resources

- Reason Studios Add-on Shop
- Edward Boraas Web Portal: Hyperbar
- Edward Boraas Web Portal: Hyperbar Manual
- Edward Boraas Web Portal: Hyperbar Quick Start