MONOMONO

Optocomp

Three optical compressors
for Ableton Live

v1.0

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The Leveling Amplifier

In the early sixties Jim Lawrence was an FM and TV engineering consultant in Los Angeles with a firm of his own, Teletronix Engineering. The limiters of the day turned the level down by shifting the bias of an amplifier tube, and he counted the cost: 2 to 10 percent distortion at 10 to 15 dB of reduction. With stereo broadcasting on its way, he wanted level control that left the waveform alone.

His answer, filed for a patent in May 1962, puts light in charge of the gain. He tried neon and filament lamps and chose an electroluminescent panel, which glows the instant the audio reaches it and in step with it, so nothing has to rectify the signal first. A photocell facing the panel turns the input down ahead of the first tube, and the tubes never leave their best operating point. The cell lets go quickly at first, then slowly, and slower still after heavy work, which Jim Lawrence found “free of thump and the usual working sounds peculiar to limiters and compressors.” The factory named the assembly the T4.

Teletronix built it first for broadcast, as the LA-2, whose manual dates from September 1963: a leveler to catch peaks before they could overdrive a transmitter. When Jim Lawrence presented it to the SMPTE in Los Angeles in April 1964, Teletronix was already a division of Babcock Electronics in Costa Mesa, and the LA-2A followed. Babcock’s 1967 advertisement counted “more than 800 Model LA-2A amplifiers now in use.”

In March 1967 Bill Putnam’s Studio Electronics bought the division for the LA-2A’s rights and its patent, which made it, in its own newsletter’s words, “the nation’s leading manufacturer of peak limiting devices.” Production began in North Hollywood on April 3, the first fifty were delivered by mid-June at $395 each, and in December the company became UREI. The Teletronix name stayed on the panels. Built for transmitters, the leveler found its home in studios, on voices and bass: Kevin Killen ran Elvis Costello’s vocal through one, and Rik Pekkonen liked its “warmer tube sound” on bass.

UREI kept the cell and changed everything around it. The LA-3A, shown at the AES Convention in New York in October 1969, put it in a transistor amplifier half the size, with Brad Plunkett, the new director of engineering, among those working on it, and the LA-2A left regular production that year. In 1976 the LA-4 traded the panel for an LED and added a Ratio switch. The factory kept revising all three; the next pages follow the line.

Revision History
The Tube Years

From the first LA-2 to 1969 the leveler kept one circuit: the light cell ahead of a 12AX7 amplifier, a 12BH7 output stage, and a 6AQ5 lighting the panel.

What changed around it were the owners, a slope switch, the input transformer and the cell. Optocomp L2 is modeled on UREI's drawing of 1968.

1963

LA-2

Teletronix Engineering's first leveler, in a manual of September 1963: Gain, Peak Reduction and a meter for output or reduction on a 5¼-inch panel, a T4 cell fed straight from the input transformer, and a totem-pole output. In 1964 Jim Lawrence sent T4A cells to fit, with two new resistors.

1965

LA-2A

The first known drawing, Babcock's of December 1965, keeps the LA-2's tubes, controls and meter around a T4A cell, with UTC's HA-100X at the input, and adds a rear control for FM pre-emphasis and a 230 V option. Early panels are gray and read Teletronix Engineering Co.; later ones are brushed metal, Div. of Babcock.

1966

COMPRESS/LIMIT

From serial 573 a switch on the chassis, beside the T4A socket, chooses limiter or compressor action. The addendum is dated November 1966; on Babcock's drawing the switch is added in red pen.

1967

STUDIO ELECTRONICS

Studio Electronics began building it in North Hollywood on April 3, 1967, from the drawing and manual it had bought. Its panels read Teletronix alone, without "Div. of Babcock."

1968

UREI

UREI redrew the circuit in August 1968. The drawing takes the T4A or the newer T4B, with the resistor ahead of the cells picked by hand to match each one, and in February 1969 UTC's A-10 replaced the HA-100X at the input.

1979

REISSUE

In October 1979 UREI advertised "a one-time limited re-run of genuine LA-2A Leveling Amplifiers," 200 units, as it corrected the drawing with "no circuit change." In 1992 UREI, by then part of Harman, built it once more.

SONIC DIFFERENCES

Jim Lawrence promised over 40 dB of reduction "with no increase in harmonic distortion," and a mild compression that turns into limiting 10 dB above the knee.

As the LA-2 with the rear control flat; turned up, up to 10 dB more reduction at 15 kHz than below 1 kHz. Specified cleaner: under 0.35 percent distortion, against 0.5.

A second curve of about 3:1: in the factory's words, doubling the input raises the output by 30 percent. LIMIT keeps the flat top.

As the Babcock units: the factory built them to the drawing it had bought until 1968.

From here the cell sets the sound: its panel dims with use, so an older one needs more Peak Reduction for the same work. UREI gave it three or four years.

As 1969, by UREI's account of the 1992 run: tested with "the same procedures employed in the original LA-2A manufacture."

Solid State

In 1969 the cell left the tubes for a transistor amplifier half the size, and seven years later UREI replaced the cell itself with an LED and photocells.

Optocomp L3 is modeled on the first LA-3A drawing and L4 on the first LA-4: each design at its start, before the factory's later changes.



1970

LA-3A

The T4 cell, still ahead of every gain stage, in a half-rack transistor amplifier. A transistor driver and a step-up transformer now light the panel, and Compress/Limit and a 50 or 30 dB gain switch sit at the back.

B TO E

Four revisions followed, the first in September 1970. By E a small capacitor bypasses the input resistor, the amplifier gains a little, and the meter bridge loses a resistor. By 1976 the panel read Audio Leveler and Universal Audio instead of Teletronix. The LA-3A left UREI's line between 1979 and 1981.



1976

LA-4

UREI's "Son of LA-3A": an LED and photocells in place of the T4, lit by an RMS detector, and a Ratio switch from 2:1 to 20:1. IC op-amps, a transformerless balanced input, and a black panel.

1980

SILVER PANEL

By 1980 the panel was silver, with a power LED and a rear phono jack for stereo. The factory's drawing of that year, LA-4(A), makes every IC a 4136, raises the rails from 15 to 18 V, fits sturdier output transistors, and drops the relay that muted the output at power-up.

1983

HARMAN

Harman International, the owner of JBL, agreed to buy UREI's parent company. The LA-4 outlived the sale: its drawing was revised twice that year, and dealers still listed it in 1986.

2000

UNIVERSAL AUDIO

In 1999 Bill Putnam's sons won the UREI name back from Harman and relaunched Universal Audio. Its LA-2A reissue shipped in 2000, its LA-3A in 2005.

SONIC DIFFERENCES

Faster and quieter than the LA-2A by UREI's account, with more room before it overloads, and LIMIT nears 50:1. Engineers hear less weight and more midrange.

Close to the first run: the new capacitor acts above 20 kHz, and the meter change is outside the audio path.

RMS, not peak: UREI said to follow it with a peak limiter where peaks matter. 2:1 lowers the threshold for gentle compression; higher ratios grab faster.

Slower to let go, to a technician who looked after six: late black units and every silver one release far more slowly than the early black ones.

Optocomp

Optocomp is a family of three optical compressors for Live. Optocomp L2 is modeled on the tube LA-2A, L3 on the solid-state LA-3A, L4 on the LA-4 with its LED and Ratio switch. In each the music drives a light and a photocell turns the level down, so the timing follows the music: there is no Attack or Release, only how hard you drive it.

They share that idea and much of a panel, but not their manners. Each grabs at its own speed, lets go at its own pace and colors the sound its own way, so this manual takes them side by side first, then each on its own.

L2



L4

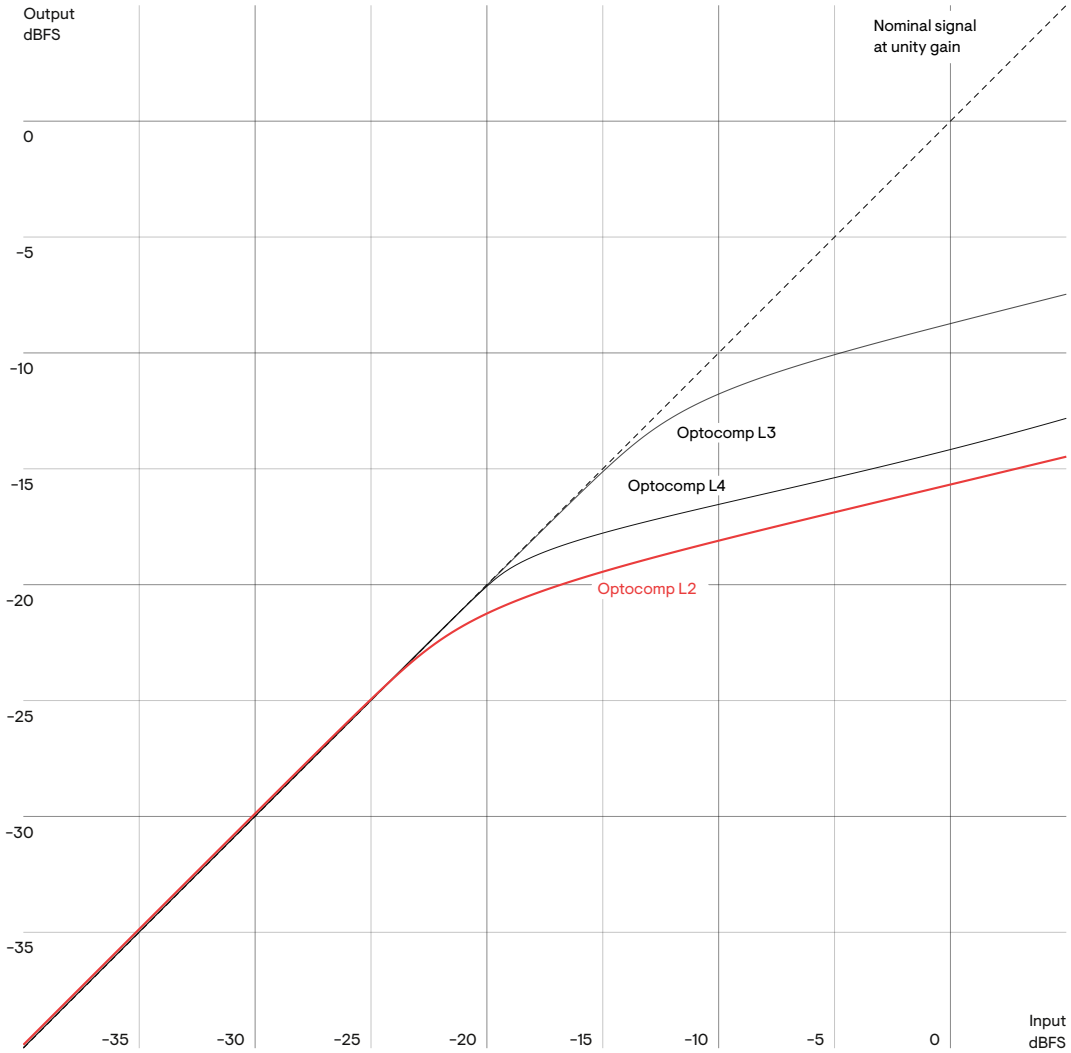


L3



Three Curves

Set all three with the dial at half, L4's Ratio at 4:1 and Input and Output at unity, and they look like one family: past the knee each climbs at much the same gentle slope, keeping some of the music's rise without letting it run away.



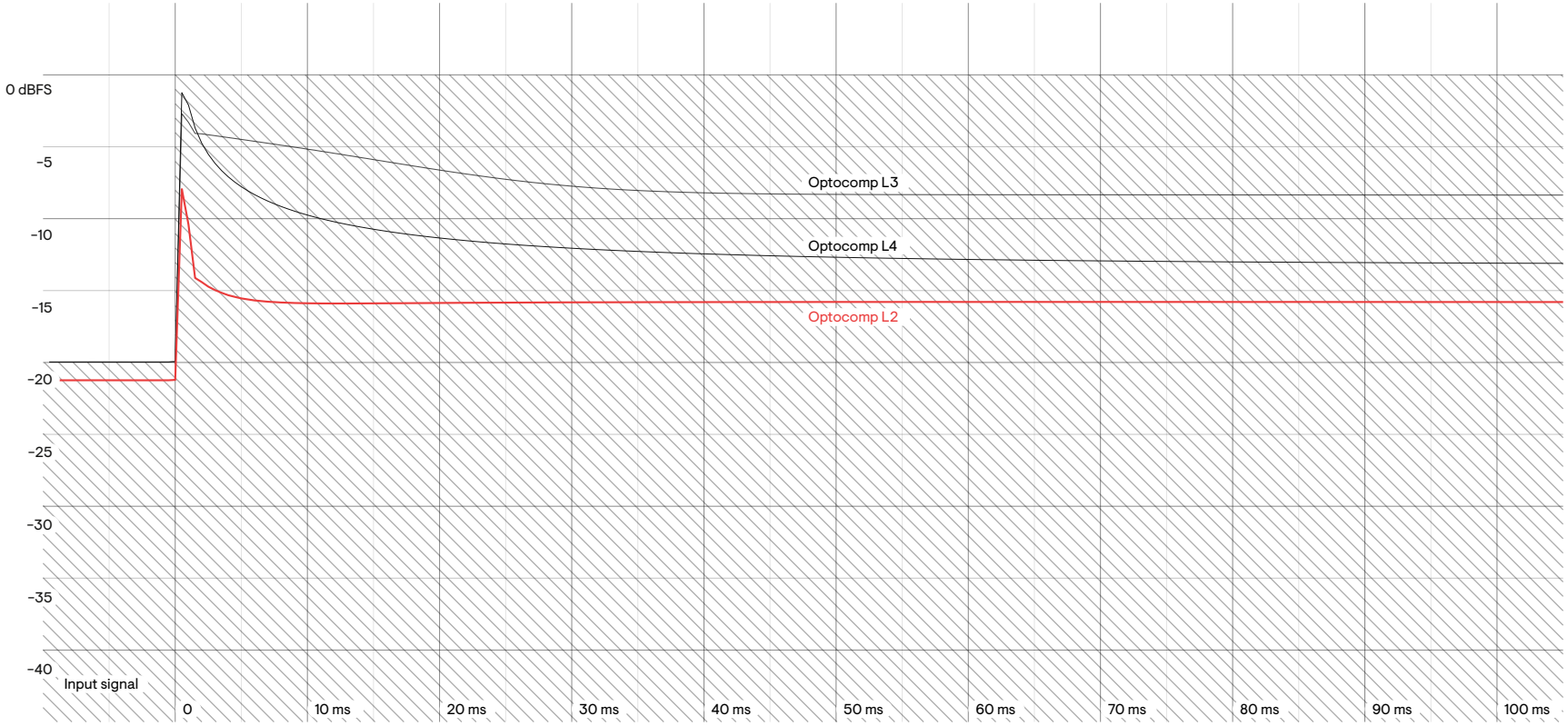
Where they part is the start. Optocomp L2 begins first, with a wide, gradual knee that is already at work well below full scale. L4 starts a few decibels later and turns the corner more firmly. L3 waits longest and lets a loud signal through noticeably hotter.

So at the same dial position L3 is the lightest touch of the three and L2 the deepest: at half, L2 settles a vocal in, L3 only takes the tops.

To hear them at the same depth, give L3 more Peak Reduction: at around 8 it starts where L2 does at half. Then the difference left is how they move, which the next two pages show.

How Fast They Grab

None of the three has an Attack control: how fast it grabs is the light cell's own nature, and it shows most in how much of a note's front gets through. Here a steady tone jumps from below the knee to full scale, each device with its dial at half.



Optocomp L2 is the quick one: almost at once most of its reduction is in place, so the edge of a word barely gets past and the attack sounds rounded.

L3 is the slowest to take hold. It lets the front through a few decibels hot, then sinks into place over the next few dozen milliseconds: a strum or a snare keeps its bite while the body is leveled.

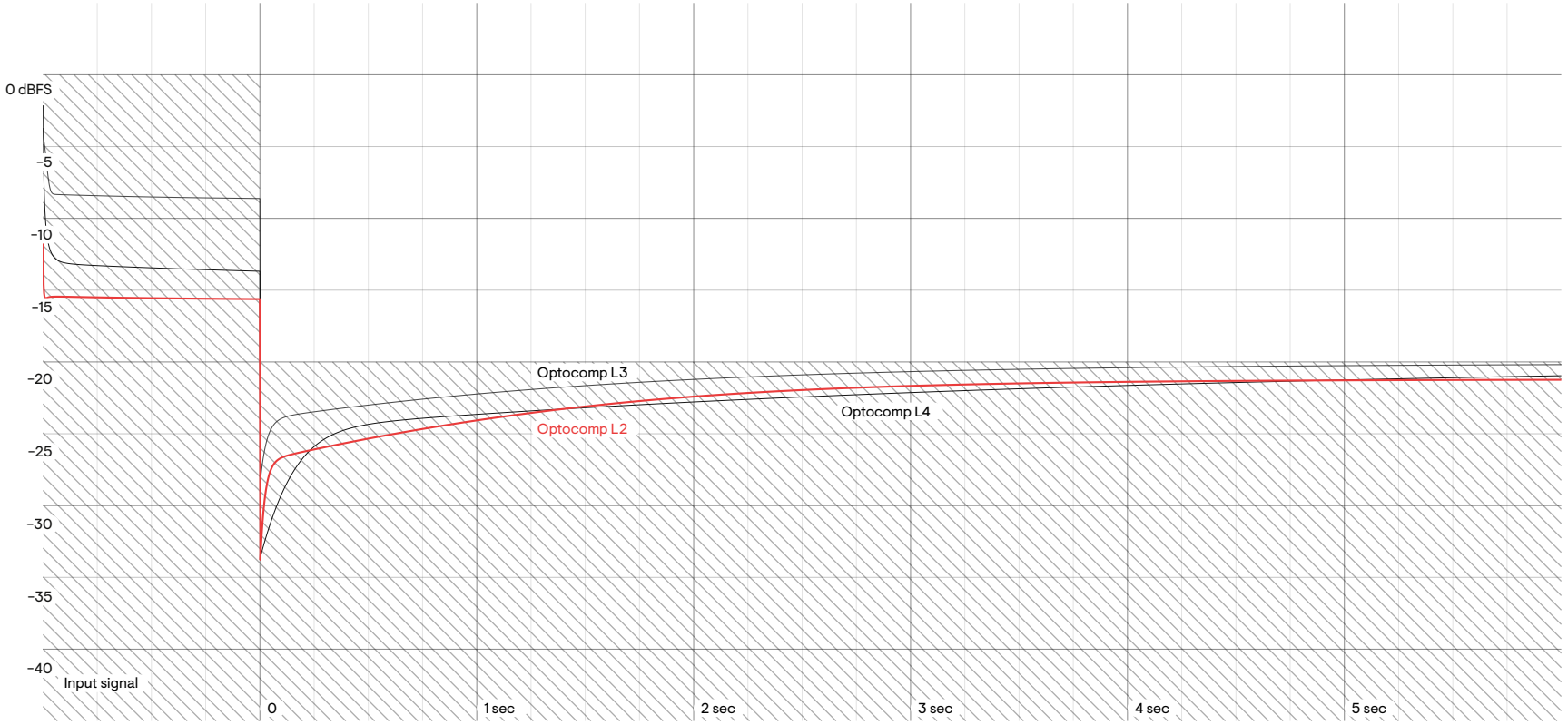
L4 takes a first bite within a few milliseconds, then eases the rest in, the last of the three to reach full depth. It sounds even rather than grabbed, and Threshold barely changes that.

How They Let Go

The release is where an optical leveler earns its name. A tone jumps into reduction for a moment and falls back, each dial at half.

All three let go in the two stages of a light cell: a quick first step that gives back about half, then a slow drift for the rest. What differs is how quick the first step is and how long the drift lasts.

All three remember: after a short peak they let go within a fraction of a second, after a long passage the tail stretches out by seconds.



Optocomp L2 lets go fastest: half its reduction is back almost at once, so the next word comes straight up, while the last decibels creep back over a couple of seconds.

L3 has the same shape, a little slower in both stages: a touch more hold between phrases, a little more glue on a part that plays through.

L4 holds on longest. Its first step is several times slower than L2's, and long after the other two have let go it is still holding some level back: less breathing, more leaning, an even hand on bass.

What L2 is Great at 

Quick and thick.

The fastest grab of the three and by far the most color, growing richer the harder you lean on it. It holds a part still without squeezing the life out of it, and its release breathes with the music.

Lead vocals held steady without losing their breath

Bass, evened out and rounded

Input up for growl on drums and room mics

Parallel warmth with Blend, the dry hits on top

What L3 is Great at 

Open and clean.

Slower to take hold, so the front of each note comes through, with little color above the bass. Its dial works in finer steps, which makes small, exact moves easy.

Electric guitars that should keep their pick attack

Backing vocals that sit together

A snare that keeps its crack

Piano and keys, leveled without thickening

What L4 is Great at 

Steady and transparent.

The longest hold of the three and the cleanest sound until its input stage clips, with a ratio switch from a gentle squeeze to a firm limit.

Bass and acoustic guitar under a slow, even hand

Gentle leveling on a group or the mix bus at 2:1

A part that must not move, at 20:1

Vocals that should stay themselves

Optocomp includes all three. They share one way of working, so learning one teaches you the others; then try each on the same part and let your ears pick.

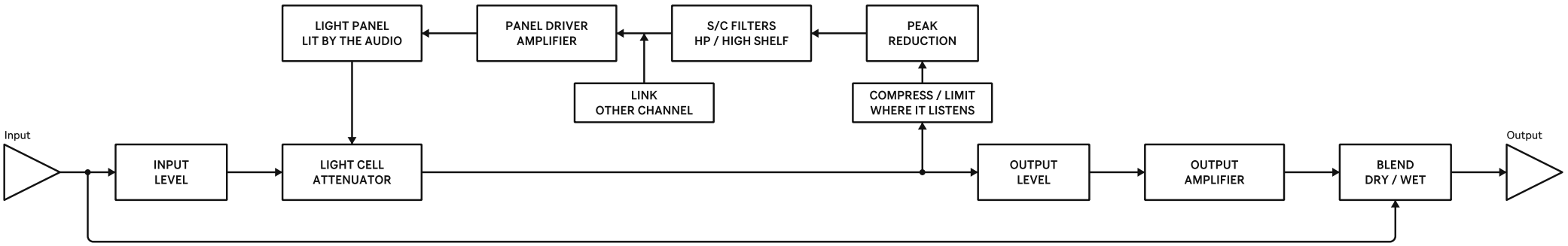
Optocomp L2


Comp 76 A
Sidechain
Stereo
HP Freq
79.5 Hz
High Shelf
0.0 dB
OUTPUT
BLEND
LIMIT
COMP
INPUT

Signal Path

Optocomp L2 is modeled on the original circuit part for part. The audio passes Input, then the light cell that turns it down, then Output, the tube amplifier and Blend. The sidechain lights a small glowing panel facing the cell: Peak Reduction sets how hard, its filters shape what it hears, and Link joins the other channel.

Nothing rectifies or smooths the signal on its way to the panel: the panel answers at once, and the cell sets the timing. Output, the amplifier and Blend come after the listening point, so they set the level and the mix, never the amount of compression.



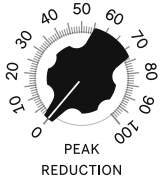
Light Instead of Volts

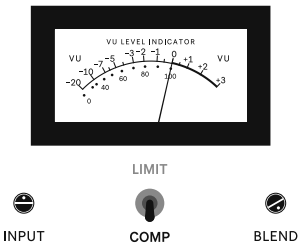
Most compressors measure the signal and turn the result into a control voltage. L2 works with light: the brighter the panel, the further the cell turns the level down. The cell grabs faster the harder it works, lets most of the reduction go quickly and the rest over seconds, and holds on longer after a long loud passage (pages 16, 18 and 19).

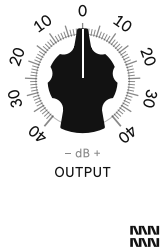
Compress and Limit move the listening point. In Compress the sidechain hears the signal after the cell, already turned down: every bit of reduction lowers what it hears, so the curve bends over gently. In Limit it listens further ahead of the cell, to more of the incoming level, and holds a firmer ceiling; Limit Curve on the back sets how far (page 17).

The Panel

Optocomp L2 reads left to right: Peak Reduction, the meter with the Compress / Limit switch and two small trims under it, and Output. There is no Attack or Release: the light cell keeps its own time, and what you set is how hard the signal drives it.







PEAK REDUCTION

How hard the signal lights the cell. At 0 nothing happens; each step up starts the reduction lower and takes it deeper (page 15).

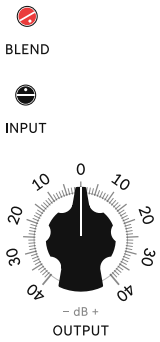
METER, COMPRESS / LIMIT, INPUT AND BLEND

The meter reads gain reduction only, resting at 0. The switch under it picks Compress, the gentle curve, or Limit, which holds the output nearly flat once the reduction runs deep (page 17). Input, the left trim, sets the level into the cell, 12 dB either way: up, and the same Peak Reduction compresses harder. Blend, the right trim, mixes the plain input back in for parallel compression (page 14).

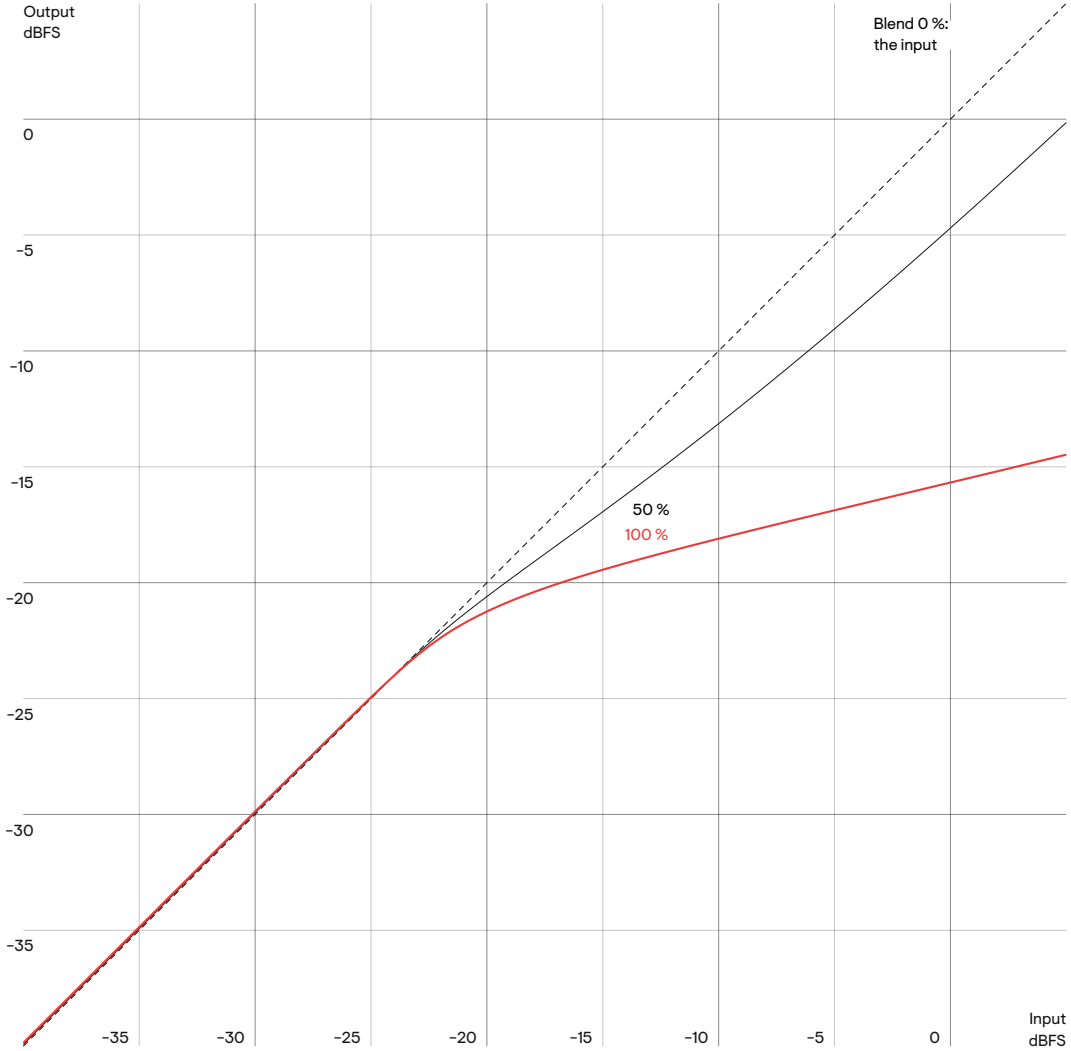
OUTPUT

How loud the result comes out, after the compressor: it never changes the amount of compression. The logo turns the device around: the back shows the transfer curve for your settings, Limit Curve and the serial numbers (page 46).

Input, Output and Blend

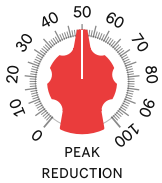


Input sets how hard the signal drives the cell: turn it up and the same Peak Reduction compresses harder, with more level too. Output comes after the compressor and only sets how loud the result is, so set the compression first and the level last.

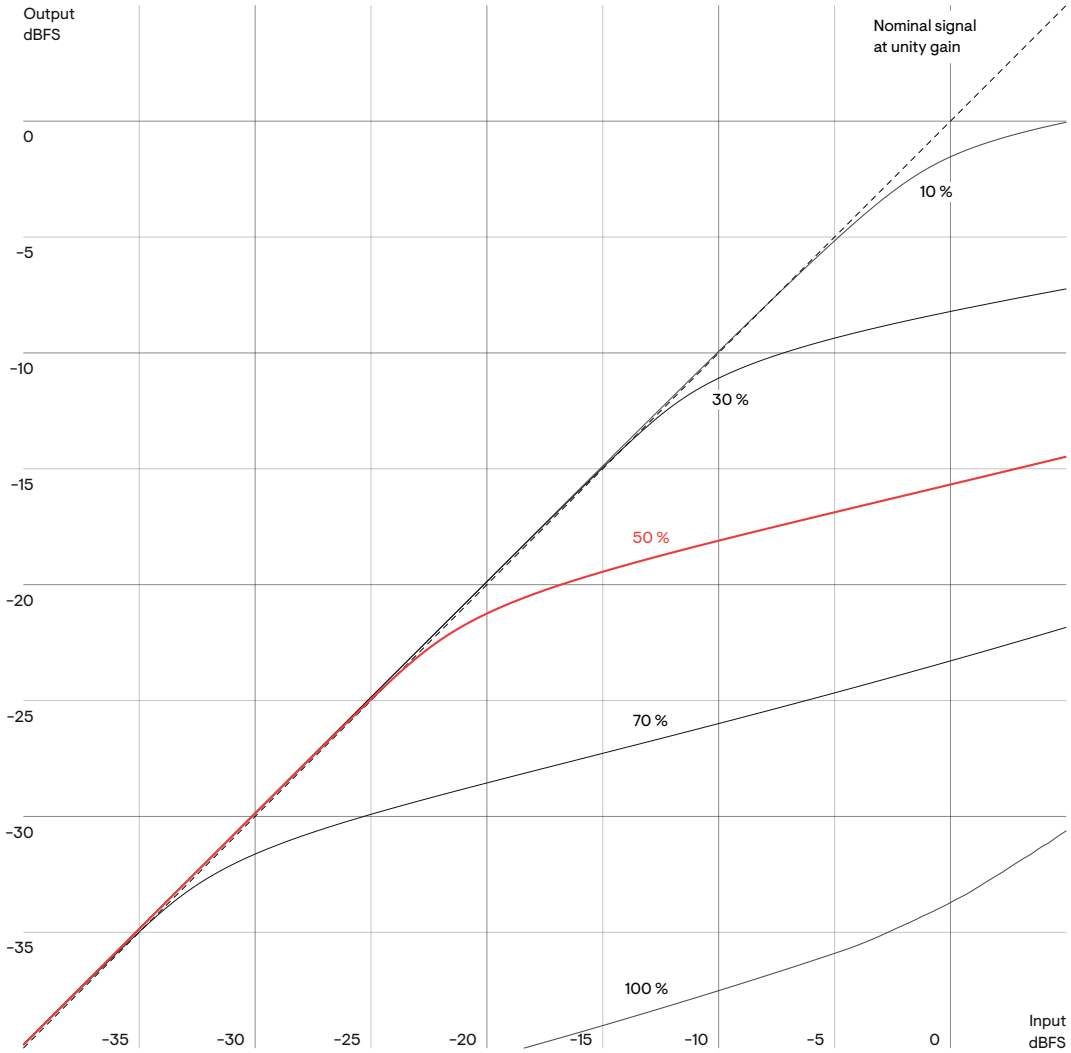


Blend mixes the plain input back in at unity, for parallel compression without a second track. Below the knee nothing changes; above it the dry peaks come back under the held signal, so the part keeps more life and stays in check.

Peak Reduction



On L2 one knob does the compressing. Peak Reduction sets how much of the signal reaches the light cell, and with it both where compression begins and how deep it goes; there is no threshold, ratio or timing beside it. It loads at 0, where nothing is reduced, and the chart sends a steady tone through as the dial turns.



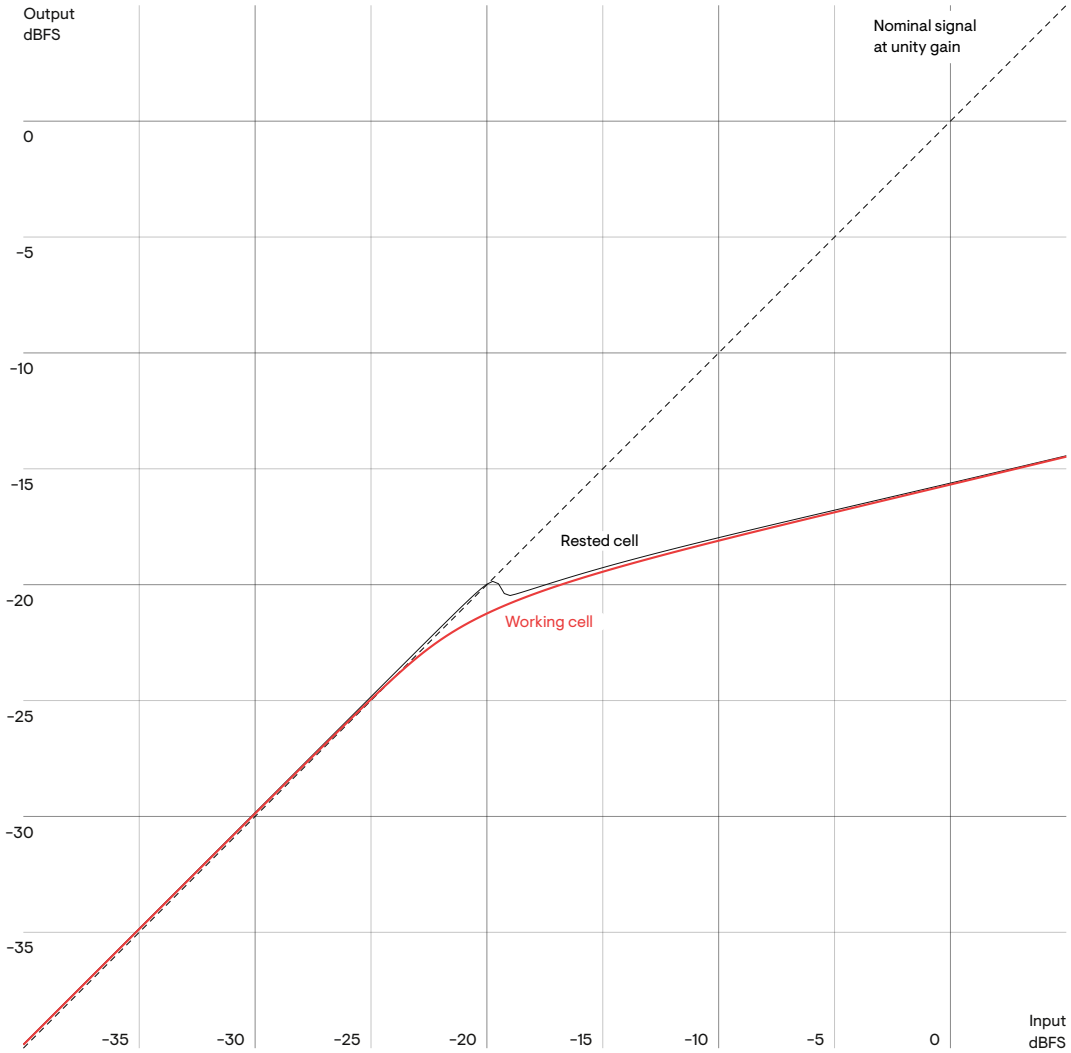
Red is the dial at half. Compression begins gently: the curve leaves the straight line in a long, wide bend rather than at a corner, so you never hear it switch on, and a loud tone comes out well held. The other curves show how evenly the dial is laid out: every step moves the start of compression by much the same few decibels and takes more off the peaks, from a light hold on the loudest moments low on the dial to reduction on almost everything near the top. Turned all the way up, the curve above its knee leans back to a gentler slope, and L2 rides the whole part down rather than squeezing its peaks.

Input drives the cell the same way: turn it up and there is more to compress. Output comes after the cell and sets the level only, so set Peak Reduction first, then bring the level back with Output.

The Cell Remembers



Every other chart in this manual shows the cell at work. As on the hardware, L2's cell has a memory, and after a rest it is slow to start. The chart sends the same steady tone through twice, with Peak Reduction at half: once into a cell that is already working, once into one that has just come out of silence.



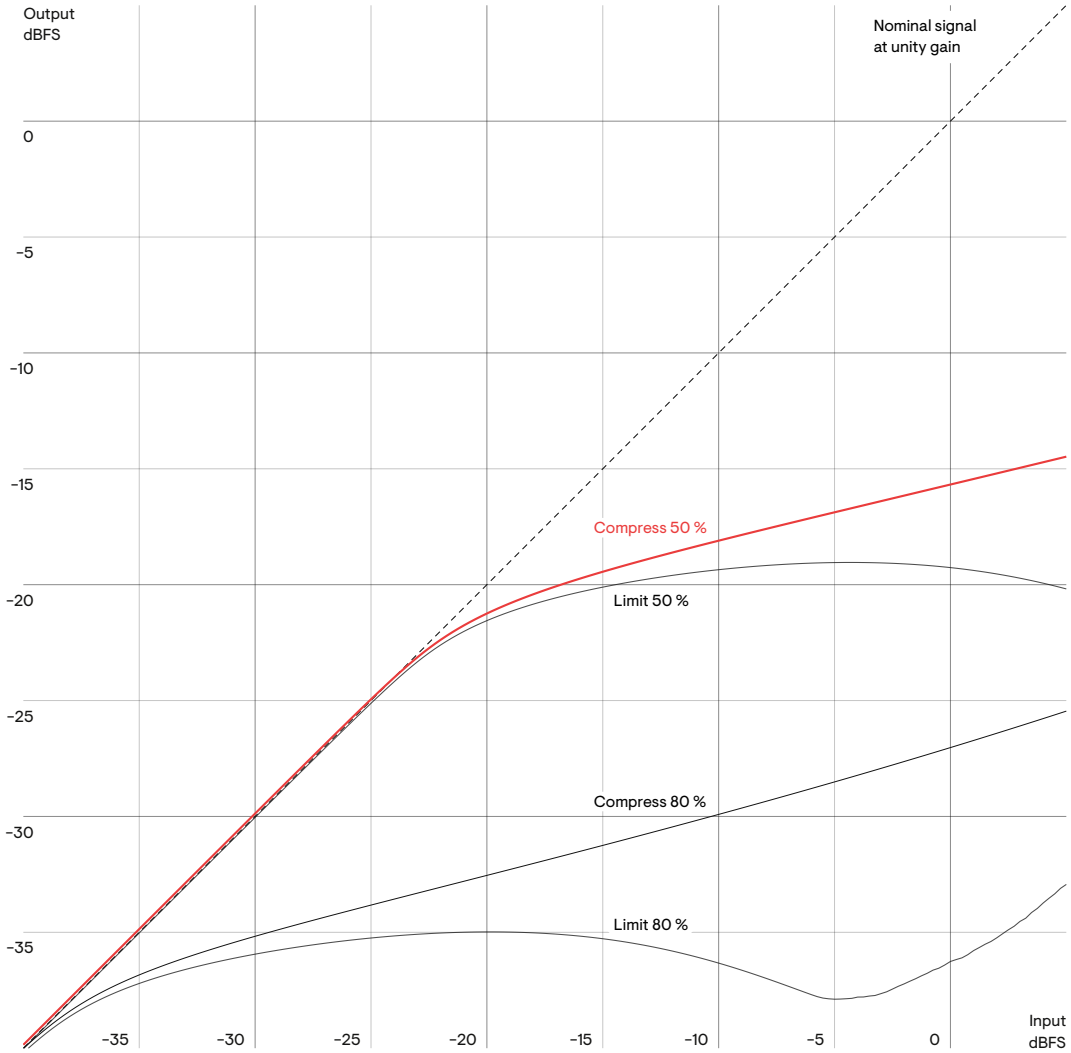
Red is the working cell, the soft knee of the Peak Reduction page. The black line has rested: right at the knee it lets the first decibel or so through, even dipping a little as the cell catches up, and it takes a second or more to settle in. Only the knee is affected: a few decibels past it the two read the same, and the closer a part sits to the knee, the longer the cell takes to settle.

You hear it as the first phrase after a long rest sitting a touch prouder than the rest of the take, never as a switch. If that first phrase matters, start the take a few bars early and the cell is awake when it arrives. L3 uses the same cell and remembers the same way.

Compress and Limit

The switch under the meter shapes the curve above the point where compression begins. Both settings start in the same place; what changes is how firmly they hold once past it.



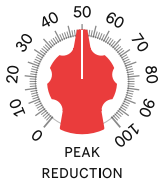


Red is Compress, the default, with Peak Reduction at half: a gentle curve, loud passages still louder, only closer. Limit bends harder: past its knee the output stops rising and even sinks a little, so a louder note comes out no louder. Turn deeper and the gap widens: Limit takes more off the top, and near full scale its curve dips and then climbs back.

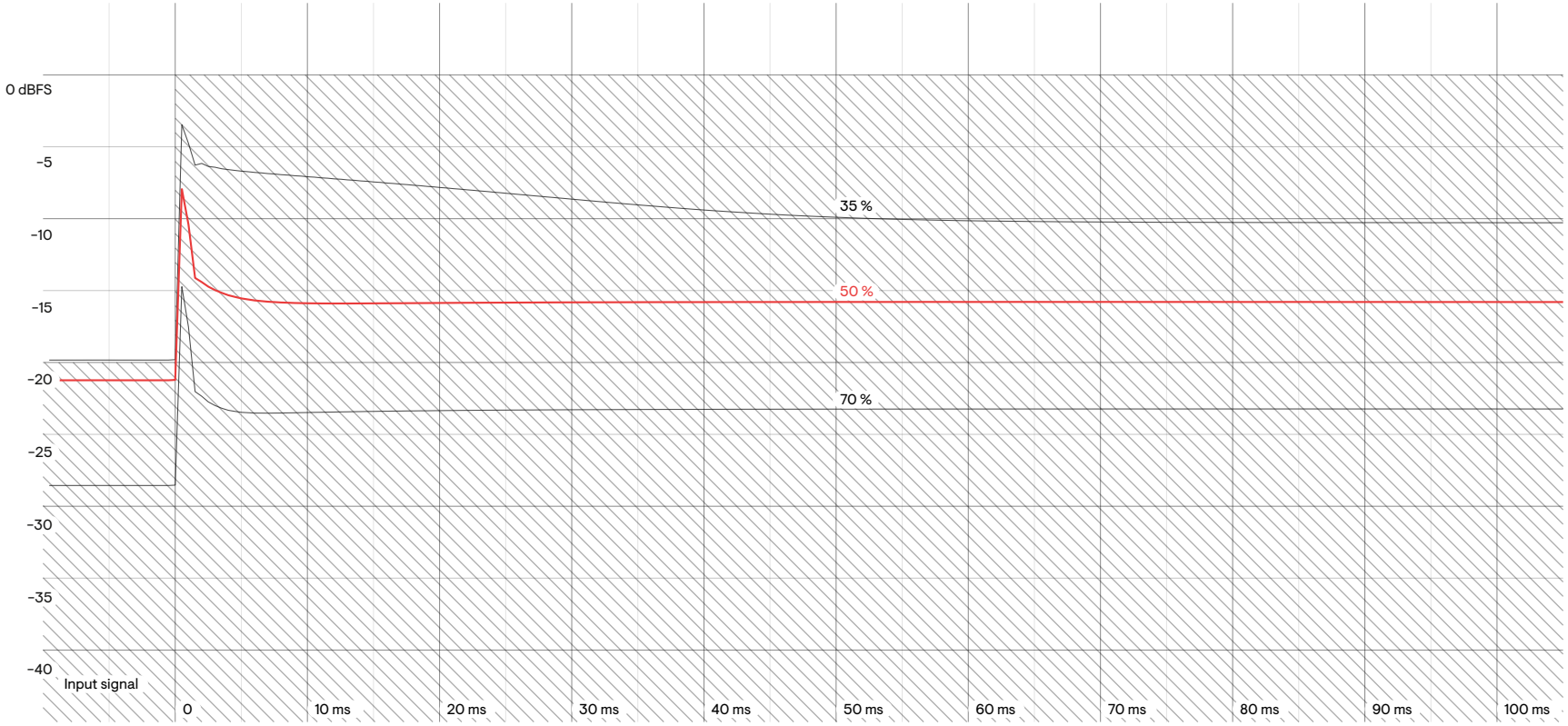
On the back, Limit Curve sets what Limit does past its ceiling: fully down the output keeps creeping up, around the middle it holds about flat, and fully up, the default, it holds and then sinks back as the input keeps climbing. Compress ignores it.

Compress holds vocals and bass and keeps the phrasing; Limit stops peaks where they are.

Attack



There is no Attack control: the light cell sets its own pace, and how hard you drive it decides how fast it closes. A steady tone jumps from below the knee to full scale, and the chart follows the first moments after the step.



At half the step is caught at once: nearly all the reduction is in place within a few milliseconds, and a vocal or bass note is held from its first cycle.

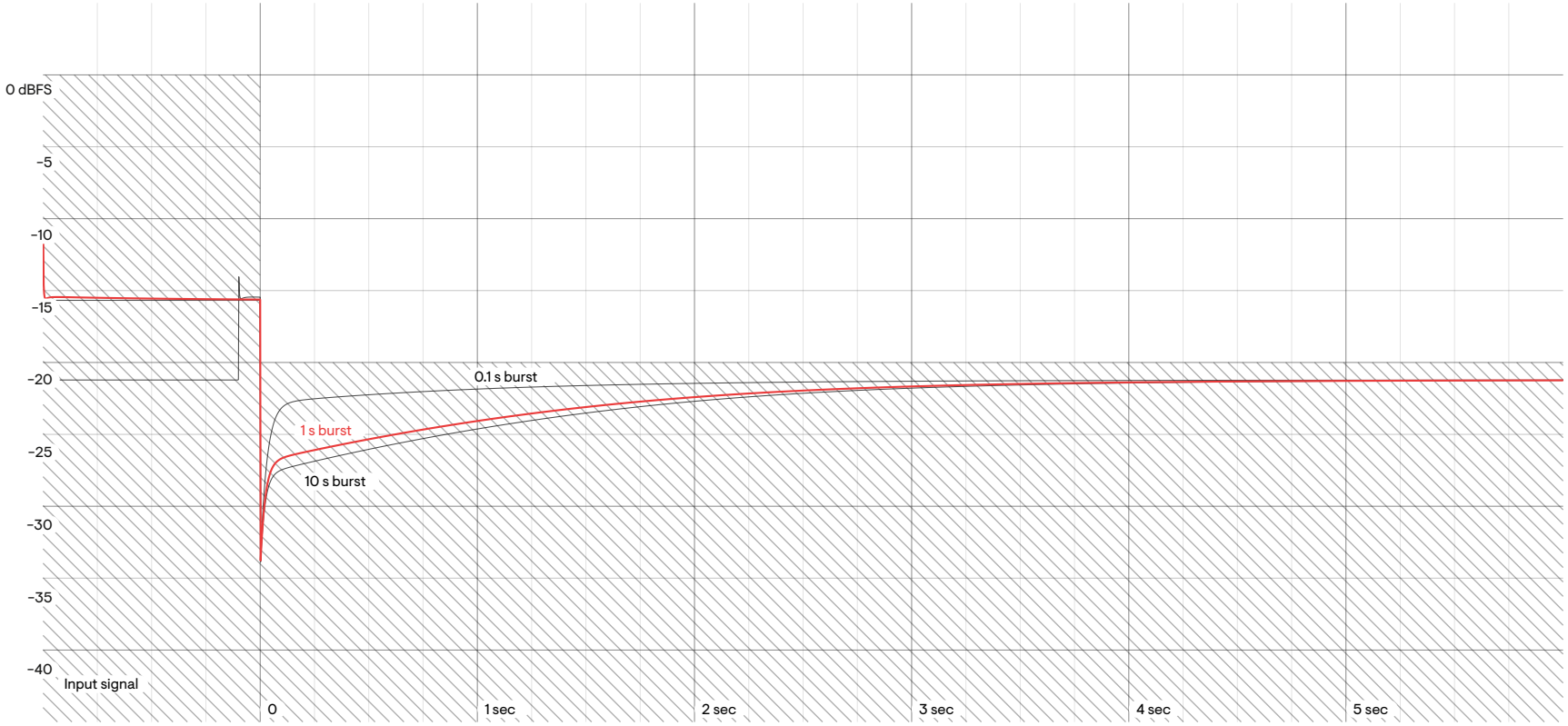
At 35 % the cell grabs in two moves, a quick dip and then a slower glide, so the front of each note comes through a little louder.

So the deeper you set it, the firmer the grab; at 70 % it closes as fast as at half. For more of the transient at a given depth, bring Blend down rather than looking for a slower setting.

Release



L2 lets go the way the cell does: quickly at first, then slowly, and more slowly the longer it has worked (page 9). A steady tone jumps well into reduction for a short, a longer and a long burst, then drops back, and the chart follows the gain as it returns.



After the middle burst, in red, half the reduction is gone almost at once, so the next phrase is not swallowed.

The rest comes back over a couple of seconds, a slow, even rise rather than a pump, which keeps the level steady across a line.

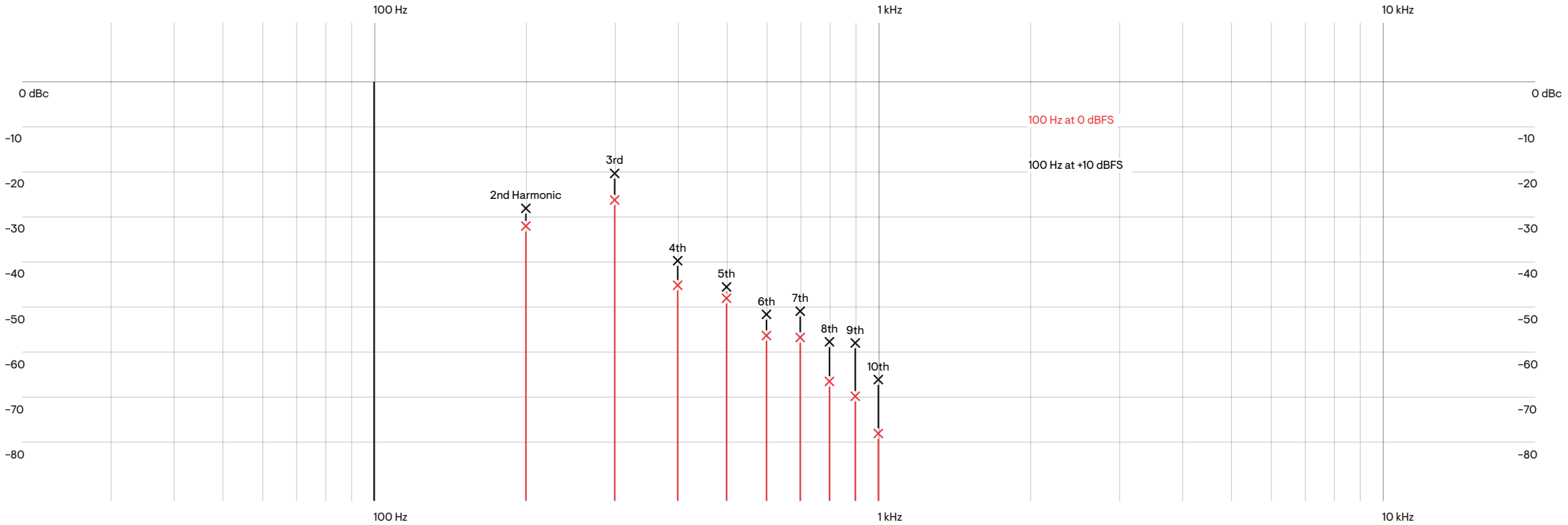
On L2 the memory lives in the tail: the first half always returns almost at once, while the slow part grows from a fraction of a second to a couple of seconds. If a quiet passage after a loud one sounds held down, ease Peak Reduction back so there is less to give back; there is no faster setting.

Harmonics at 100 Hz

A 100 Hz tone at 0 dBFS in, +10 dBFS in black. Each cross marks a harmonic's level under the tone: −20 dBc is a tenth of it, −40 dBc a hundredth.

Start low, where L2 has the most to say. On a 100 Hz tone with Peak Reduction at half, the second and third harmonics stand side by side, with a long train of higher ones behind them. The second is what sets the bass apart: far stronger than on a 1 kHz tone (next page), it adds weight and warmth to a low note as L2 holds it.

The black crosses are pushed harder, and the whole train comes up: on a bass leaned on hard, that is growl you can hear. If a bass line gets too thick, ease Input back a little or bring Blend down.

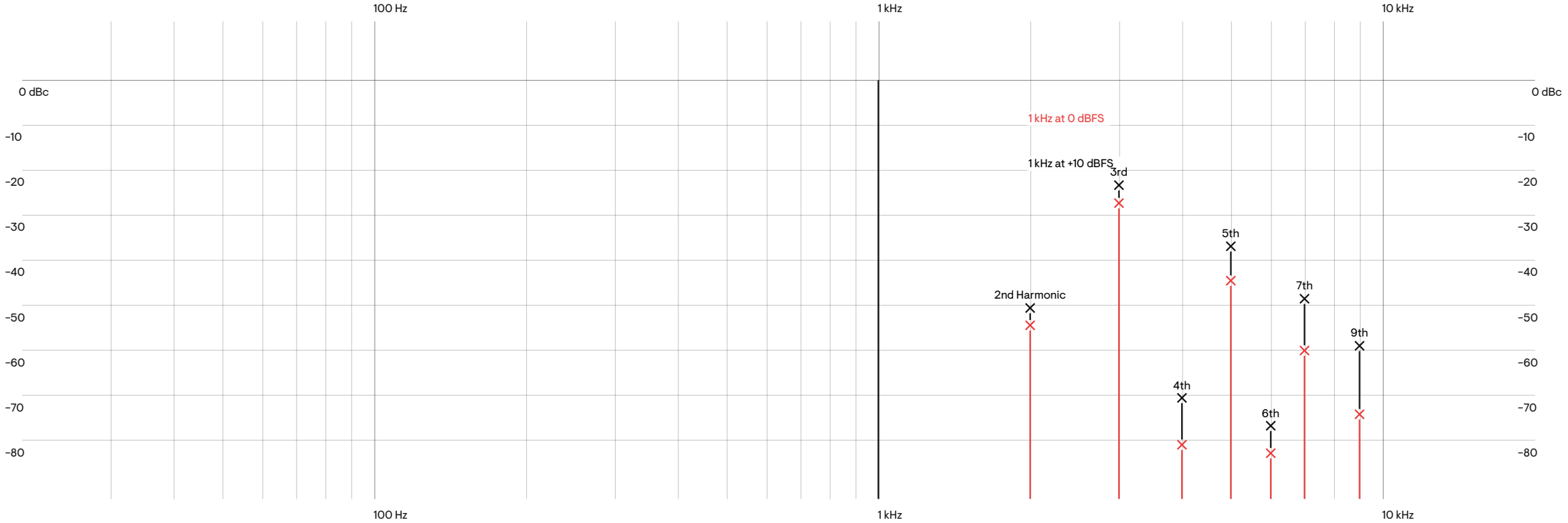


Harmonics at 1 kHz

A 1 kHz tone at 0 dBFS in, +10 dBFS in black. Each cross marks a harmonic's level under the tone: −20 dBc is a tenth of it, −40 dBc a hundredth.

Higher up, L2's color turns odd. The red crosses are a 1 kHz tone with Peak Reduction at half, well into reduction: the third harmonic leads, the fifth, seventh and ninth step down beneath it, and the second sits far behind. That ladder of odd harmonics is the density and slight edge you hear when L2 holds a voice hard.

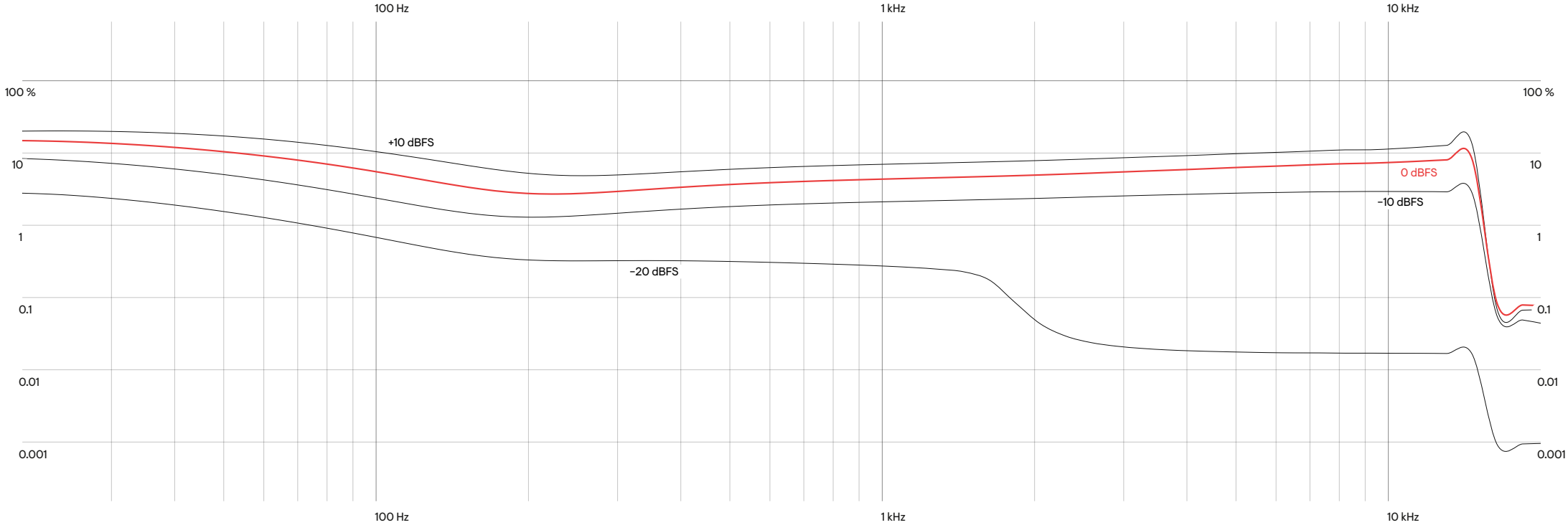
The black crosses are the same tone pushed harder: every rung comes up, and faint even ones join in. Below the knee almost none of it is there; it arrives with the compression and grows with it. Ride a vocal lightly and the color stays faint; drive it until the meter sits deep and the sound thickens. For the hold without the color, bring Blend down.



Distortion

A sine at 0 dBFS in, −20, −10 and +10 dBFS in black. Higher means more distortion: at 1 % the added harmonics sit 40 dB under the tone, at 0.01 % 80 dB under.

Across the band L2's color has a shape. A sine sweeps from the lowest bass to the top at four input levels, Peak Reduction at half. Red is a full-scale sine, the unit well into reduction: colored everywhere, most in the deepest bass, least in the low mids, and climbing again through the mids into the top. The black curves show how it builds. Where compression is only beginning, the low end already carries some color while the top stays clean. A little harder and the whole band comes up together, and pushed harder still it rises again: the harder L2 works, the more it adds, top end included. There is a second source as well. With Peak Reduction at 0 and Output at unity, the output stage starts to soften as the level nears full scale: turn Output up into it and it adds a color of its own.



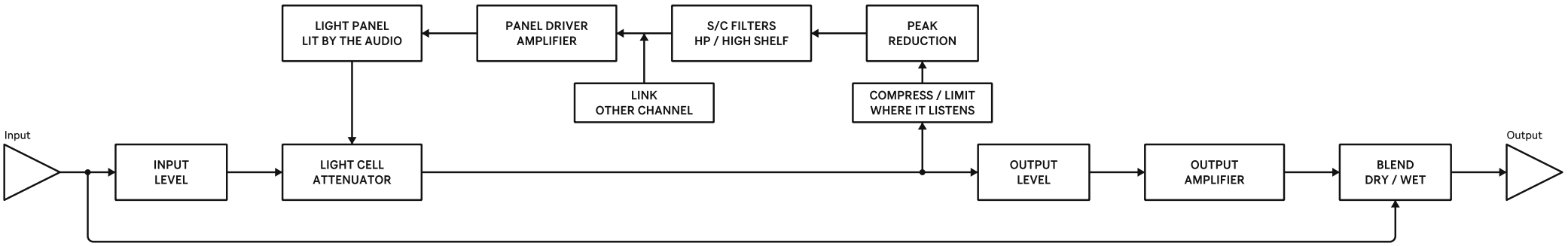
Optocomp L3


Optocomp L3
Sidechain
Dual Mono
HP Freq
78.8 Hz
High Shelf
0.0 dB
PEAK REDUCTION
INPUT
LIMIT
OUTPUT

Signal Path

The same path as L2's (page 12): Input, the light cell, Output, the output amplifier and Blend, with the sidechain lighting a glowing panel that faces the cell. What changes is everything around the cell: L3's amplifiers are transistors instead of tubes, and a transistor driver, fed through Peak Reduction, lights the panel.

Compress and Limit work as on L2: Compress listens after the cell, Limit further ahead of it, for a firmer ceiling. L3 has no Limit Curve: its Limit sits where the original circuit puts it.

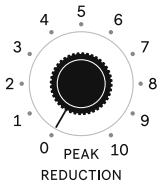


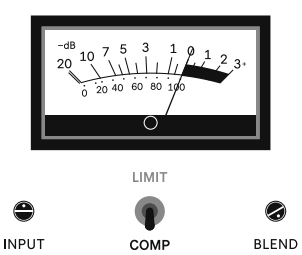
What Changes in the Sound

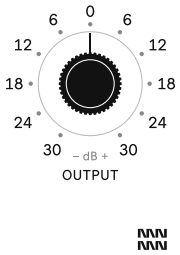
Without tubes around the cell, L3 colors the sound much less than L2, even when it works hard, and it eases into a note where L2 grabs (pages 29 and 33). Its Peak Reduction works in finer steps and reaches less deep (page 27), which makes small, exact moves easy.

The Panel

Optocomp L3 keeps L2's layout and its controls, so this page starts with what is different. It takes hold of a note more gently and colors the sound less, its Peak Reduction works in finer steps, and its Output has a shorter span. The pages that follow show every control in full.







PEAK REDUCTION

Numbered 0 to 10 instead of L2's percent. Each number is a finer step than on L2, so the same position compresses less, and the top of the dial reaches less deep (page 27).

METER, COMPRESS / LIMIT, INPUT AND BLEND

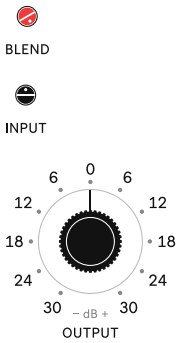
As on L2 (page 13): the meter reads gain reduction, Compress or Limit under it (page 28), Input and Blend as the two trims (page 26). L3 has no Limit Curve: its Limit is fixed.

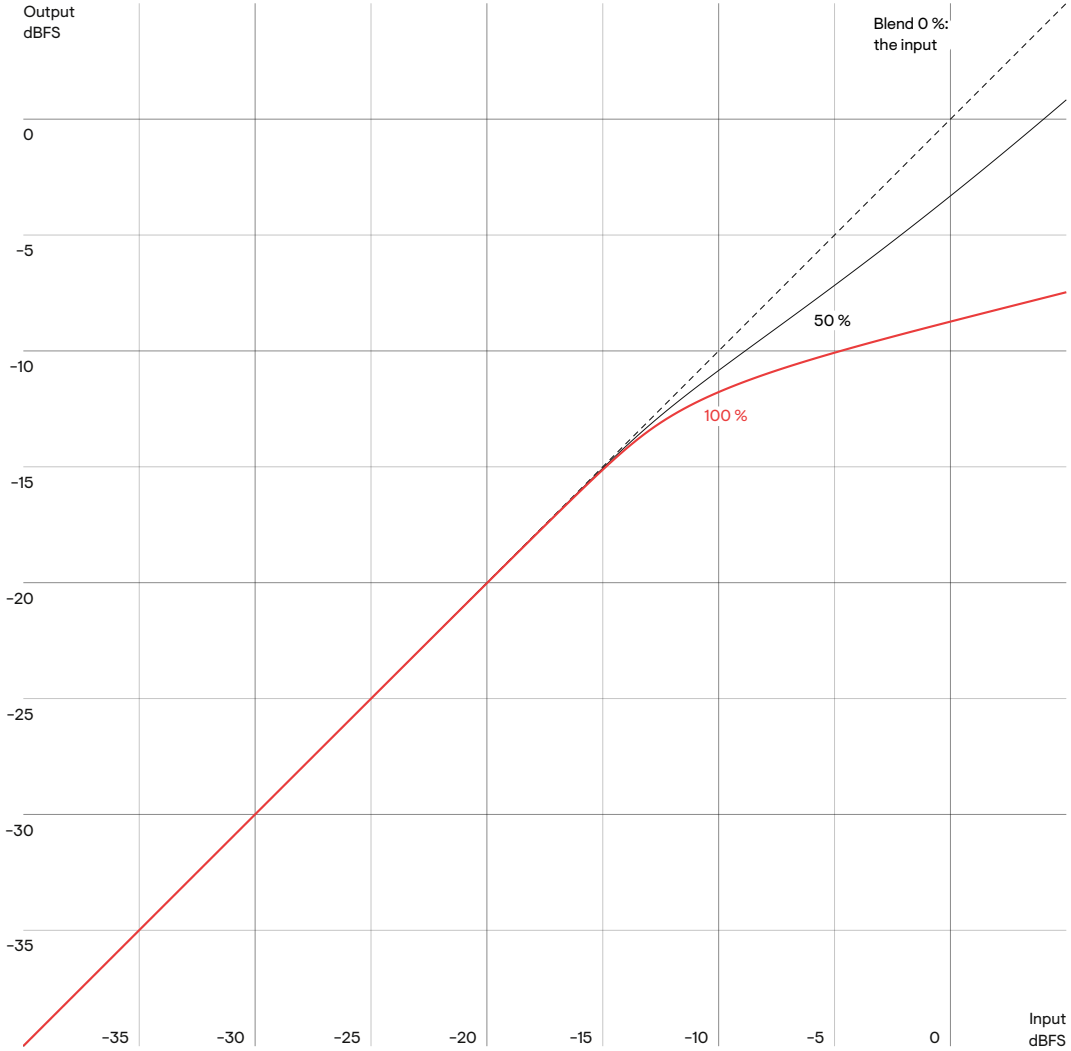
OUTPUT

−30 to +30 dB, unity at the center, after the compressor: it sets the level only. The back shows the transfer curve for your settings and the serial numbers (page 46).

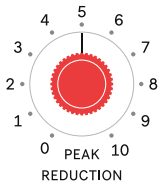
Input, Output and Blend

As on L2 (page 14): Input drives the cell, Output sets the level after it, Blend mixes the plain input back in. At 5 L3 holds less back, so Blend has less to restore. Output spans less than L2's, still plenty to match levels.

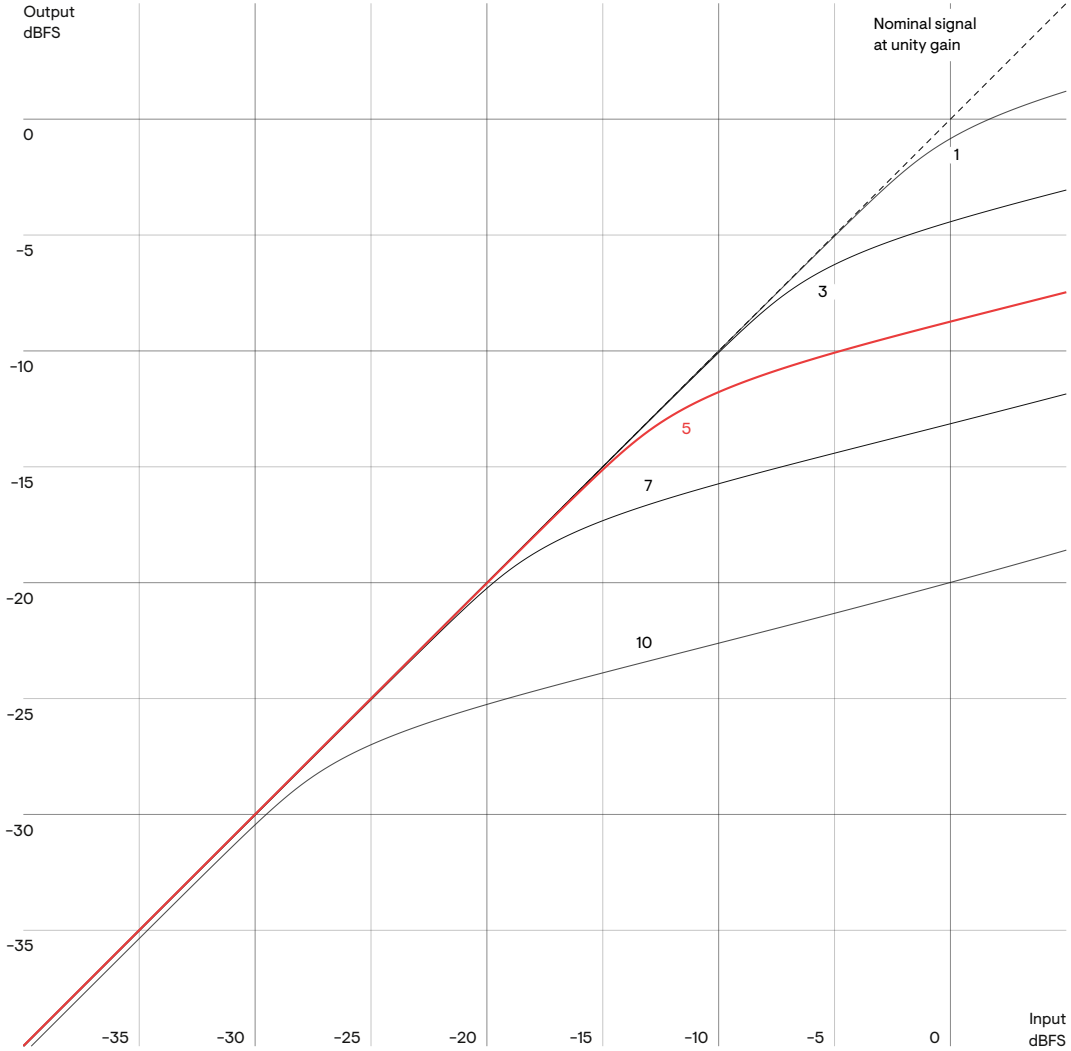




Peak Reduction



Peak Reduction works on L3 as on L2 (page 15): one dial sets where compression begins and how deep it goes, and it loads at 0. What differs is the scale. L3's dial runs from 0 to 10 and covers a little over half of L2's range, so each number is a finer step and the same position compresses less.

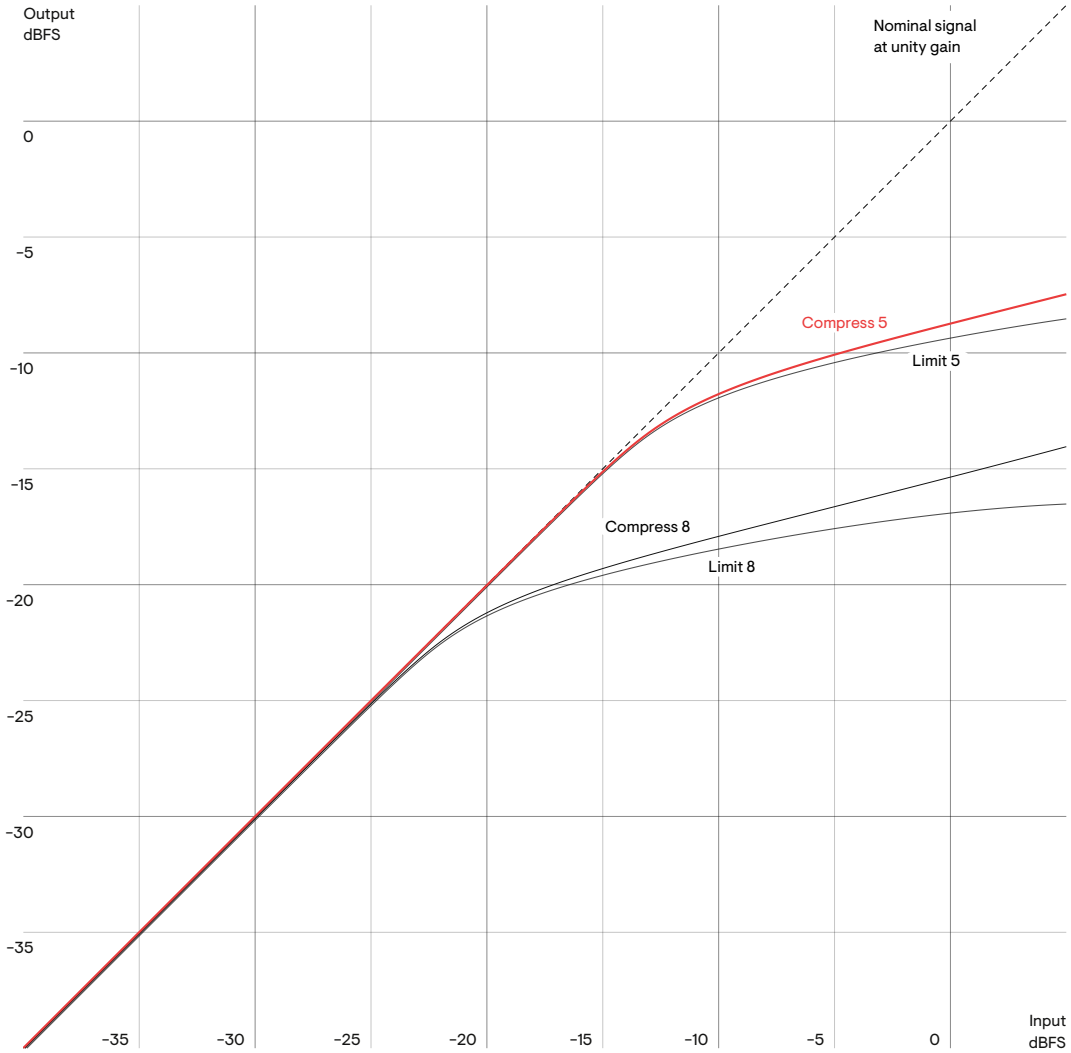


Red is 5, halfway: compression begins much later than on L2 at half, and a loud tone comes down only about half as far, light leveling where L2 is already working hard. To reach the depth of L2 at half, turn L3 to about 8. Two things set L3 apart. The steps are small and evenly spaced, so the dial is easy to set by ear across its whole travel. And once past the knee every setting runs at much the same slope, so even near the top L3 holds firmly rather than riding everything down as L2 does fully up. Set the dial by the meter and your ears, then match the level with Output.

Compress and Limit

L3 has the same switch as L2 (page 17), under the meter, but on L3 it matters only when you lean on the unit.

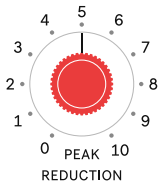




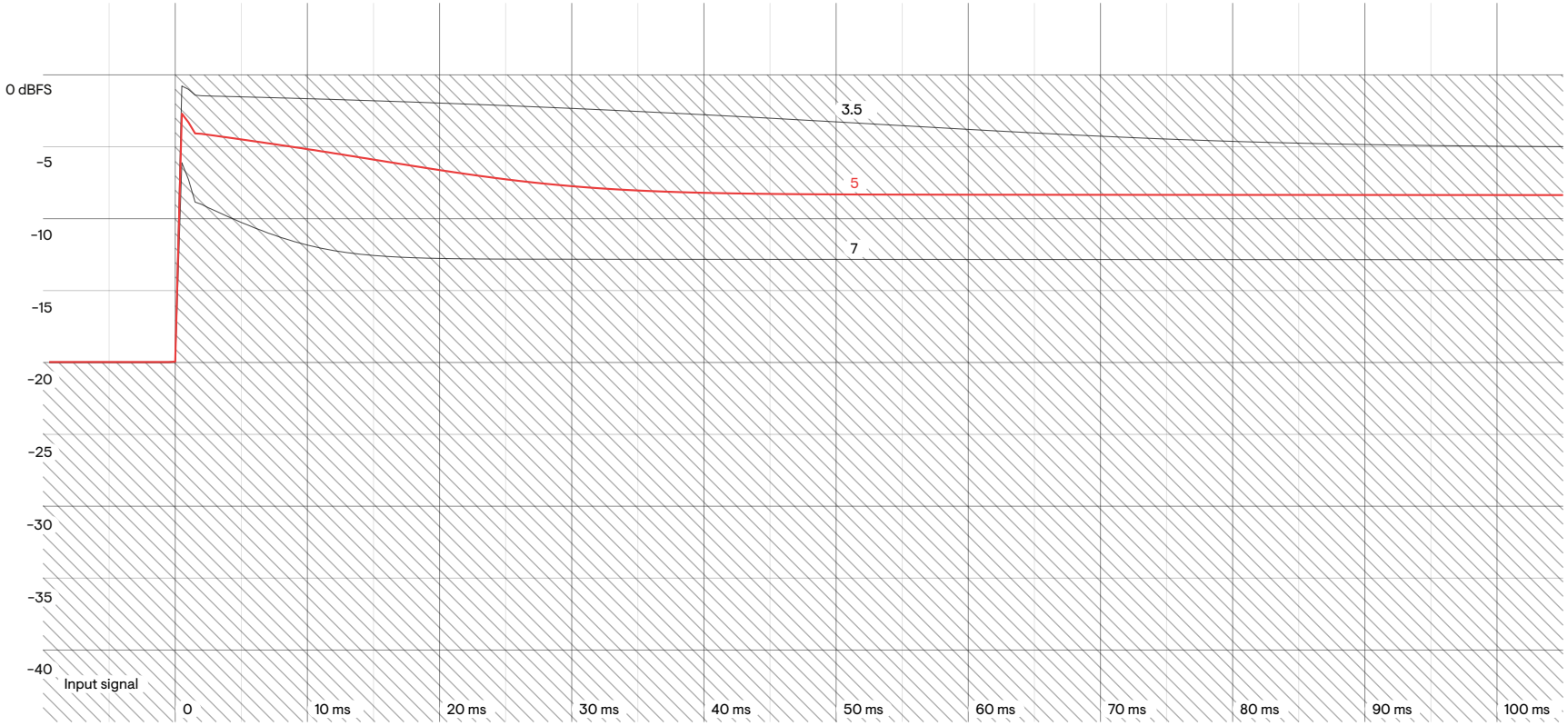
Red is Compress at 5. Limit at the same setting lies almost on top of it: at everyday levels the two are one curve, where on L2 Limit already bends harder at half. Turn L3 deeper and the difference is plain. Compress keeps its steady slope, while Limit flattens toward a ceiling as the input nears full scale, and unlike L2's it holds there rather than sinking back, so a hard-hit L3 sounds pinned, not pushed around.

Leave it on Compress for riding a vocal or a guitar, and flip to Limit when you drive L3 hard and want the peaks to stop. At moderate settings the two match, so the switch doesn't jump the level. L3 has no Limit Curve.

Attack



The same test as on L2 (page 18), and the same rule: the deeper L3 works, the faster it grabs. But at the same dial position L3 takes its time where L2 grabs at once.

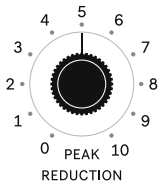


At 5 it catches part of the step at once and eases the rest down over the next few dozen milliseconds, so a note's front arrives a little hot.

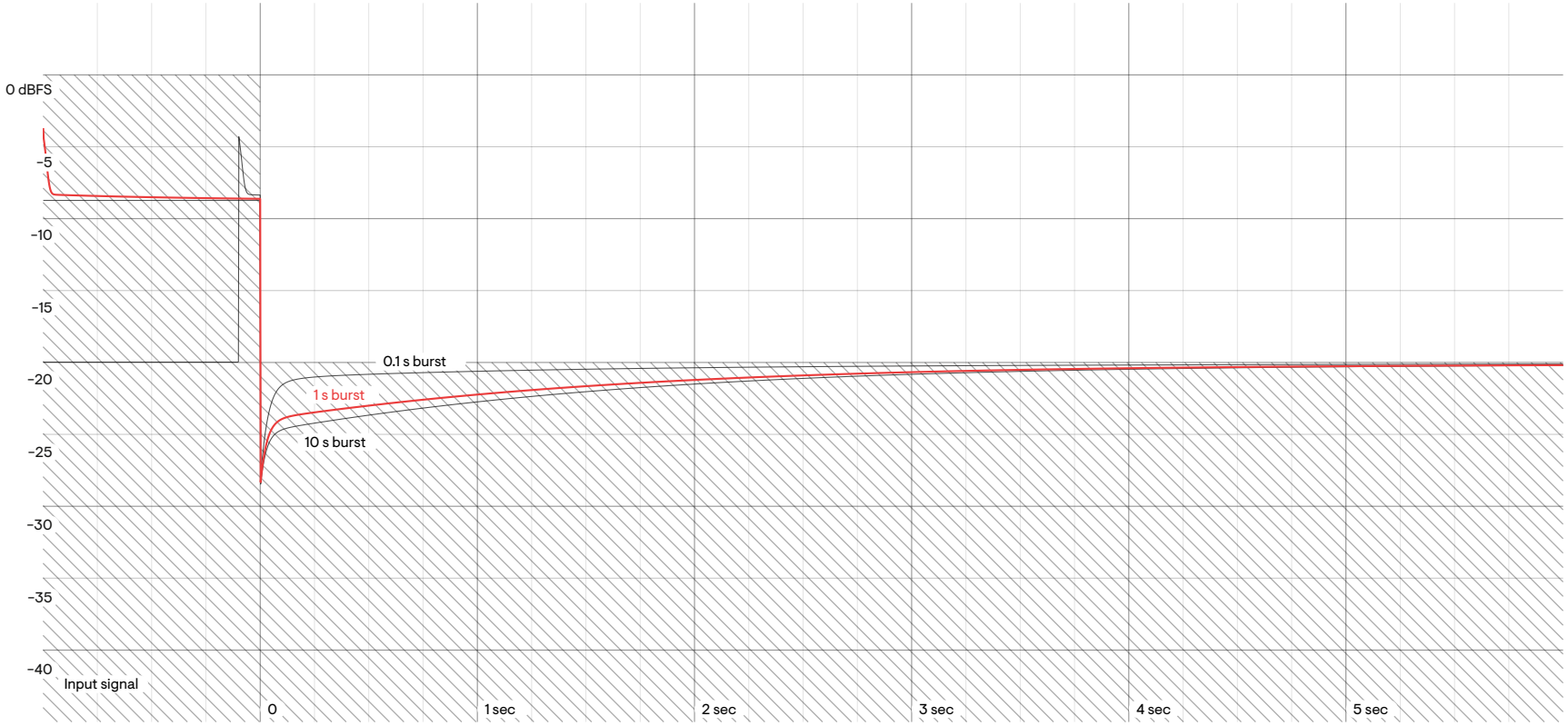
At 3.5 the glide is nearly three times as long: leveling that hardly touches the attack, for a part you want evened out.

At 7 it closes almost at once, the way L2 does at half. So on L3 the dial sets speed with depth: light settings ride, deep ones grab.

Release



The same test as on L2 (page 19). L3 releases in the same two stages, a quick first half and a slow tail, but its first stage depends far more on how long the loud passage lasted.



After the short burst L3 lets go almost at once. After the middle burst, red, the first half takes about twice L2's time.

After the long burst that first half takes nearly three times as long again: a long loud passage is eased off, not dropped.

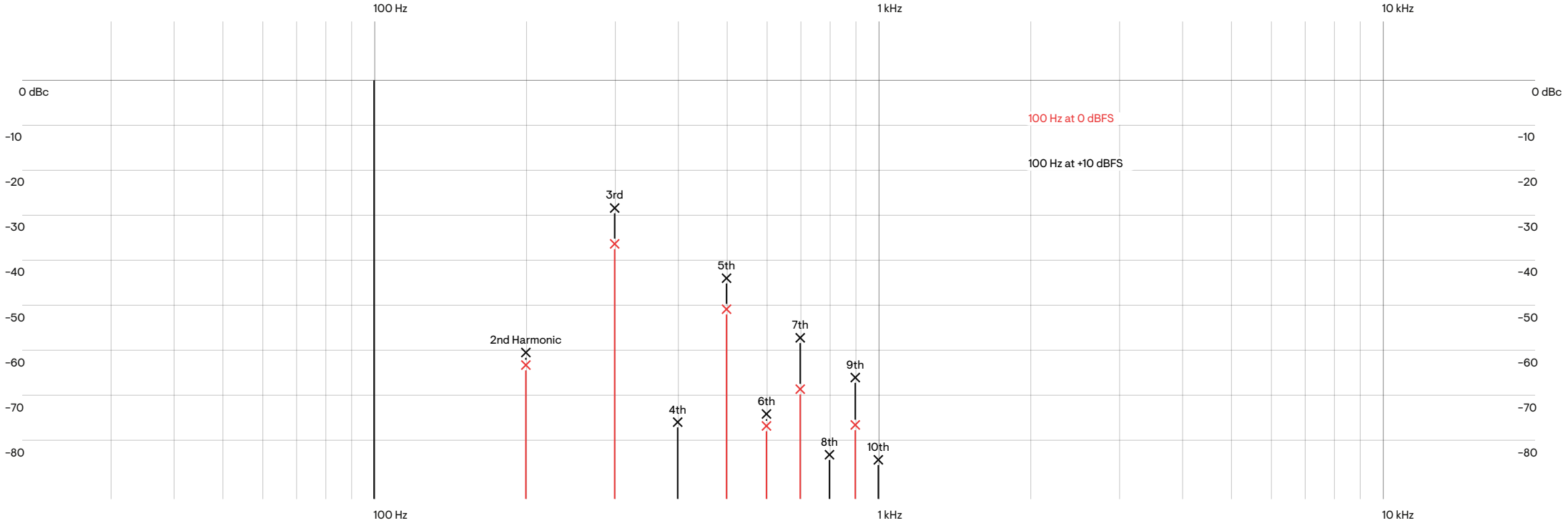
So a drum hit is let go before the next one, while a sustained chorus fades out of the compression gently into the quieter section. The tail itself is close to L2's, a little longer.

Harmonics at 100 Hz

A 100 Hz tone at 0 dBFS in, +10 dBFS in black. Each cross marks a harmonic's level under the tone: −20 dBc is a tenth of it, −40 dBc a hundredth.

Where L2 adds a second harmonic to a low note (page 20), L3 adds a third. On a 100 Hz tone at 5 the third leads, well above anything at 1 kHz (next page), the fifth, seventh and ninth fall away behind it, and the second stays low. The reason is the compression itself: a low note's cycle is long enough for the gain to move within it, and that movement bends the wave. With Peak Reduction at 0 the extra harmonics are gone, and a low note carries no more than a 1 kHz one.

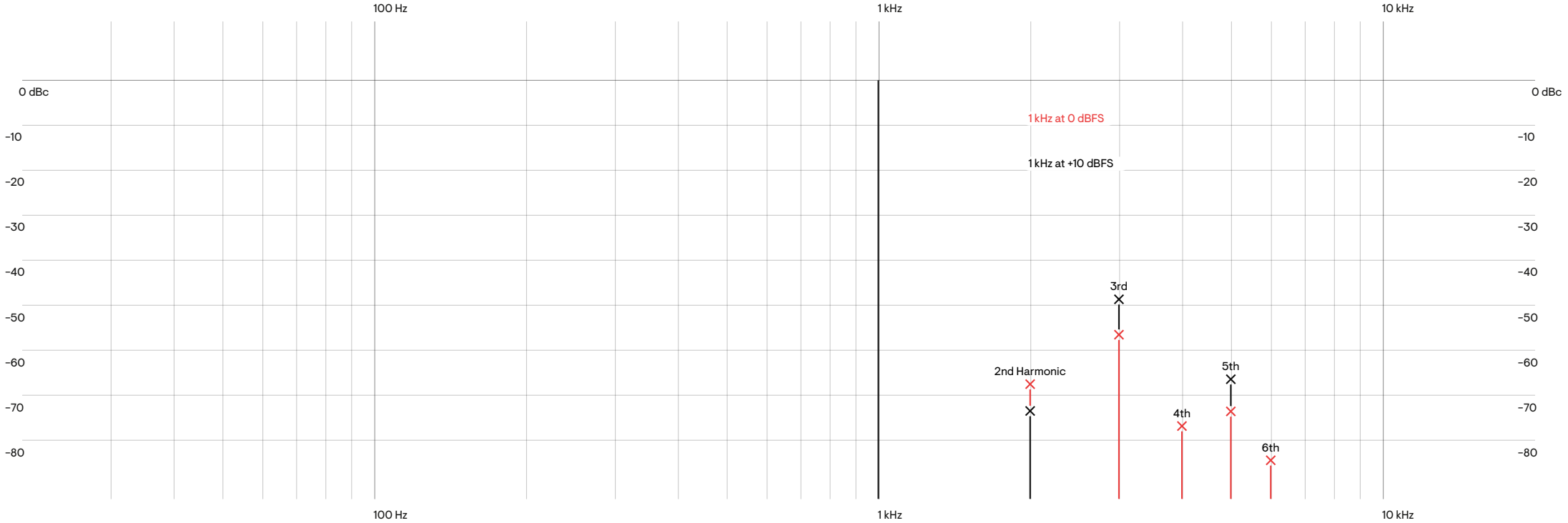
The black crosses are pushed harder, and the odd train climbs. On a bass or a kick held hard, that is a firmer, slightly gritty low end; for a rounder bottom, keep the reduction moderate or bring Blend down.



Harmonics at 1 kHz

A 1 kHz tone at 0 dBFS in, +10 dBFS in black. Each cross marks a harmonic's level under the tone: −20 dBc is a tenth of it, −40 dBc a hundredth.

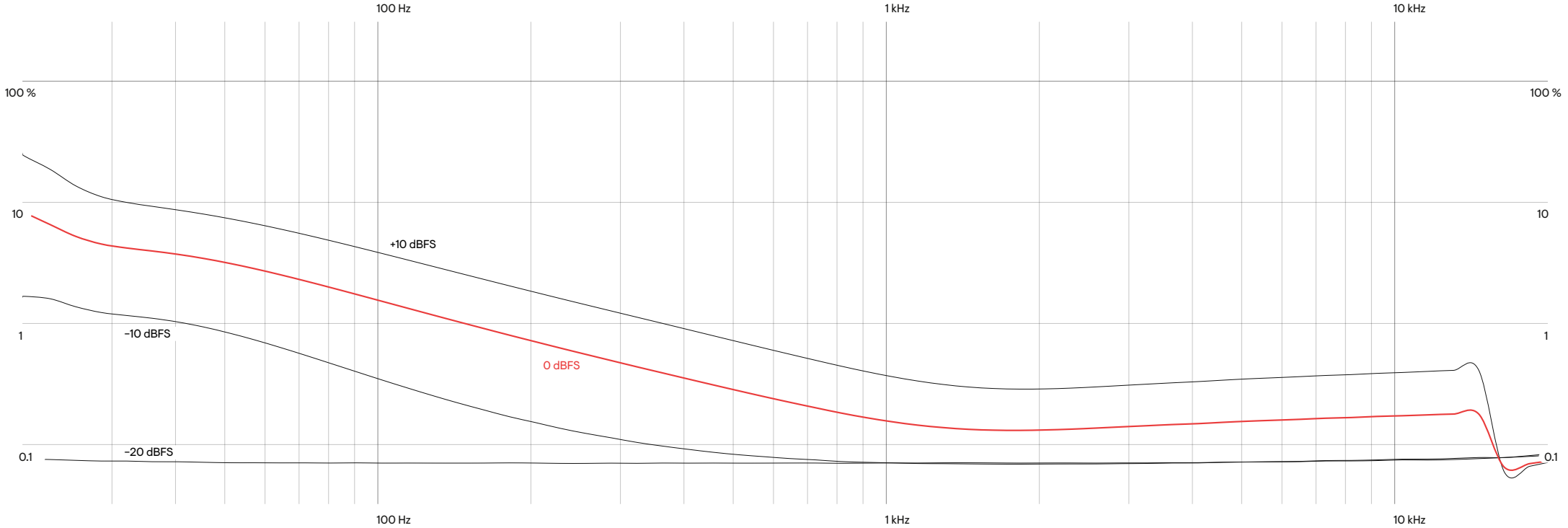
Higher up, where L2 thickens (page 21), L3 stays out of the way. The red crosses are a 1 kHz tone at 5, well into reduction: the third harmonic in front, the second behind, everything far below L2's ladder. Through the mids you hear the level being held, not the unit. The black crosses are pushed harder: the third climbs and the second falls back, still a small fraction of what L2 adds. One more trace is always there: once Peak Reduction leaves 0, a faint second harmonic sits at a constant level whether the unit compresses or not. So L3 is the one for clean leveling on guitars, vocals and piano.



Distortion

A sine at 0 dBFS in, −20, −10 and +10 dBFS in black. Higher means more distortion: at 1 % the added harmonics sit 40 dB under the tone, at 0.01 % 80 dB under.

Across the band L3 tells the opposite story from L2 (page 22): its mids and top stay clean at every level, and what it adds lives in the bass. The same sweep, the dial at 5. Under the knee the curve is flat from the lowest bass to the top: the faint even trace from the previous page, the same at every frequency. Red is a full-scale sine, well into reduction: the clean line holds from the mids up, and below them the curve climbs octave by octave into the deepest bass. Just past the knee the rise is smaller, and pushed harder it climbs higher, while the top rises only a little. So L3 colors in step with how hard it compresses low notes and leaves the rest alone. On a full mix or a guitar it levels without a trace; on bass the bottom octave firms up as the cell grabs it. Its output has plenty of room, too: at unity it stays clean well above full scale.



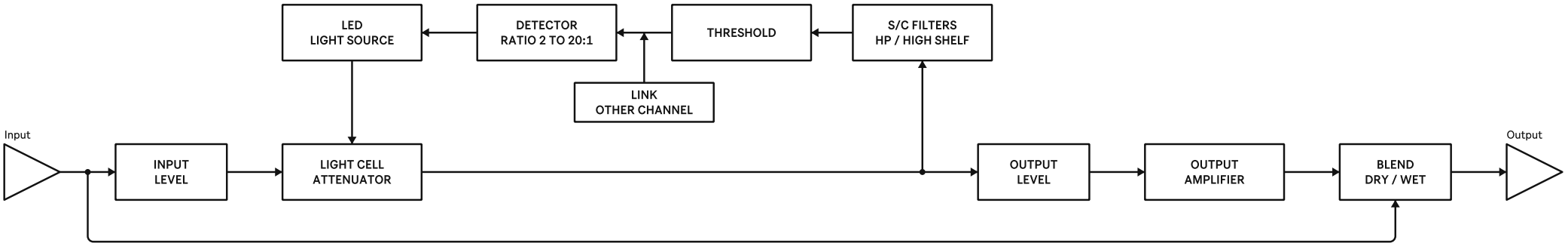
Optocomp L4


Optocomp L4
Sidechain
Dual Mono
HP Freq
INPUT
OVERLOAD
RATIO
THRESHOLD
BLEND
OUTPUT
Dyn 432
L/R
LINK
LR
M
INPUT GAI

Signal Path

Optocomp L4 keeps the light cell and changes how it is lit. The audio path is the one L2 and L3 have: Input, the light cell, Output, the output amplifier and Blend. The sidechain, taken after the cell, runs through its filters and Threshold into a detector that lights an LED, and Ratio sets how hard the detector answers; Link joins the other channel there.

The detector only rectifies: the LED lights in quick pulses, and the cell itself does the smoothing.

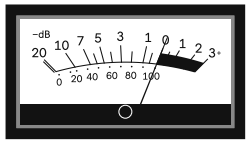


Threshold and Ratio

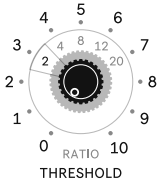
Where L2 and L3 have one Peak Reduction, L4 splits the job: Threshold sets where compression begins, Ratio how firmly the level is held past it (pages 38 and 39). It always listens after the cell, so there is no Compress / Limit switch: 2:1 is the soft setting, 20:1 the limit.

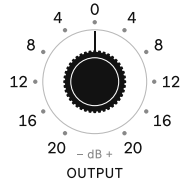
The Panel

Optocomp L4 turns the layout around: the meter on the left, then a stacked Threshold and Ratio, and Output. Its light is an LED driven by a detector, so where L2 and L3 have Peak Reduction it has a threshold and a ratio. There is still no Attack or Release: the cell keeps its own time.



INPUT OVERLOAD





BLEND

METER, INPUT AND OVERLOAD

The meter reads gain reduction only, resting at 0. Input, the trim under it, sets the level in, 12 dB either way: up, and the same Threshold compresses harder. Overload lights as the input stage reaches clipping.

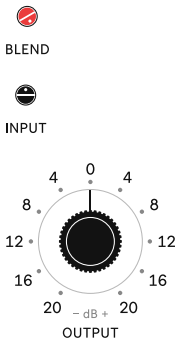
THRESHOLD AND RATIO

Threshold, the inner knob, sets where compression begins: at 0 nothing happens, and each step up lowers that point (page 38). Ratio, the outer ring, picks 2:1 to 20:1: 2:1 starts lower and softer, 20:1 limits (page 39).

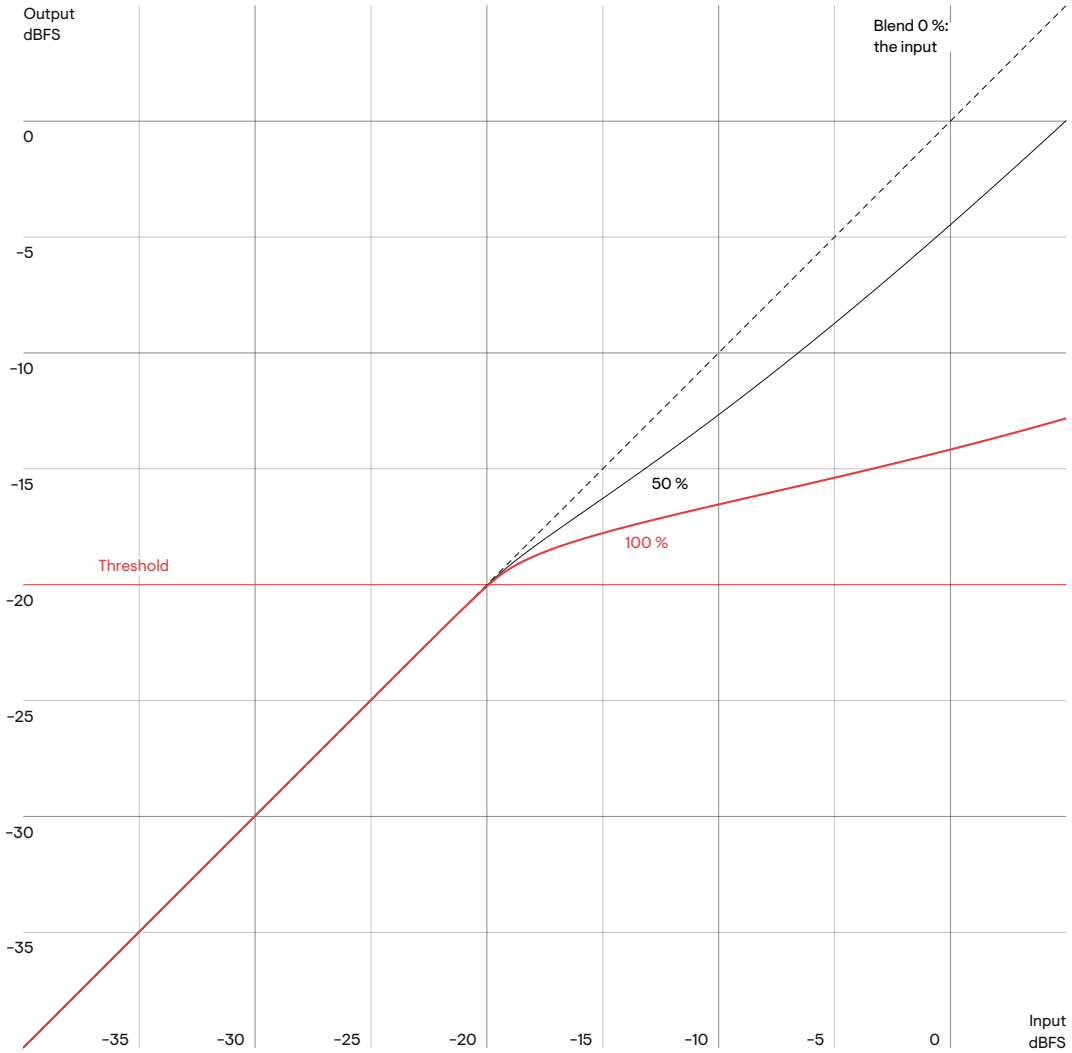
BLEND AND OUTPUT

Blend, the trim, mixes the plain input back in for parallel compression (page 37). Output sets the level after the compressor, unity at the center. The logo turns the device around: the back shows the transfer curve for your settings and the serial numbers (page 46).

Input, Output and Blend



Input sets how hard the signal reaches the detector: turn it up and the same Threshold compresses harder, with more level too. Push it far enough and the Overload lamp lights: the input stage is clipping. Output comes after the compressor and sets the level only.

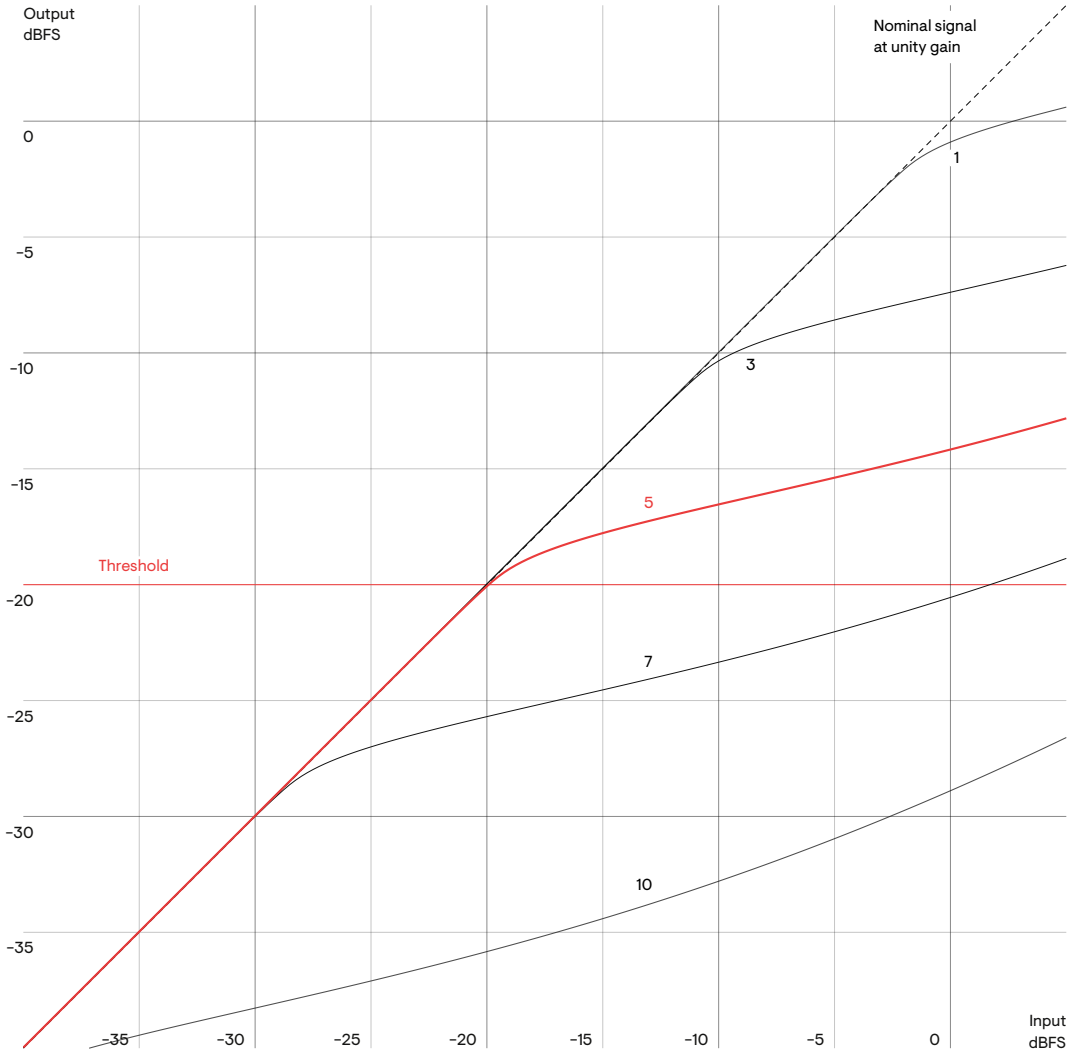


Blend mixes the plain input back in at unity, as on L2 (page 14): below the knee nothing changes, above it the dry peaks come back under the held signal.

Threshold



Threshold is the dial you'll turn most, and it decides one thing: where L4 starts to work. It loads at 0, where nothing is reduced, and Ratio loads at 2:1; the chart sends a steady tone through as Threshold turns, with Ratio at 4:1.

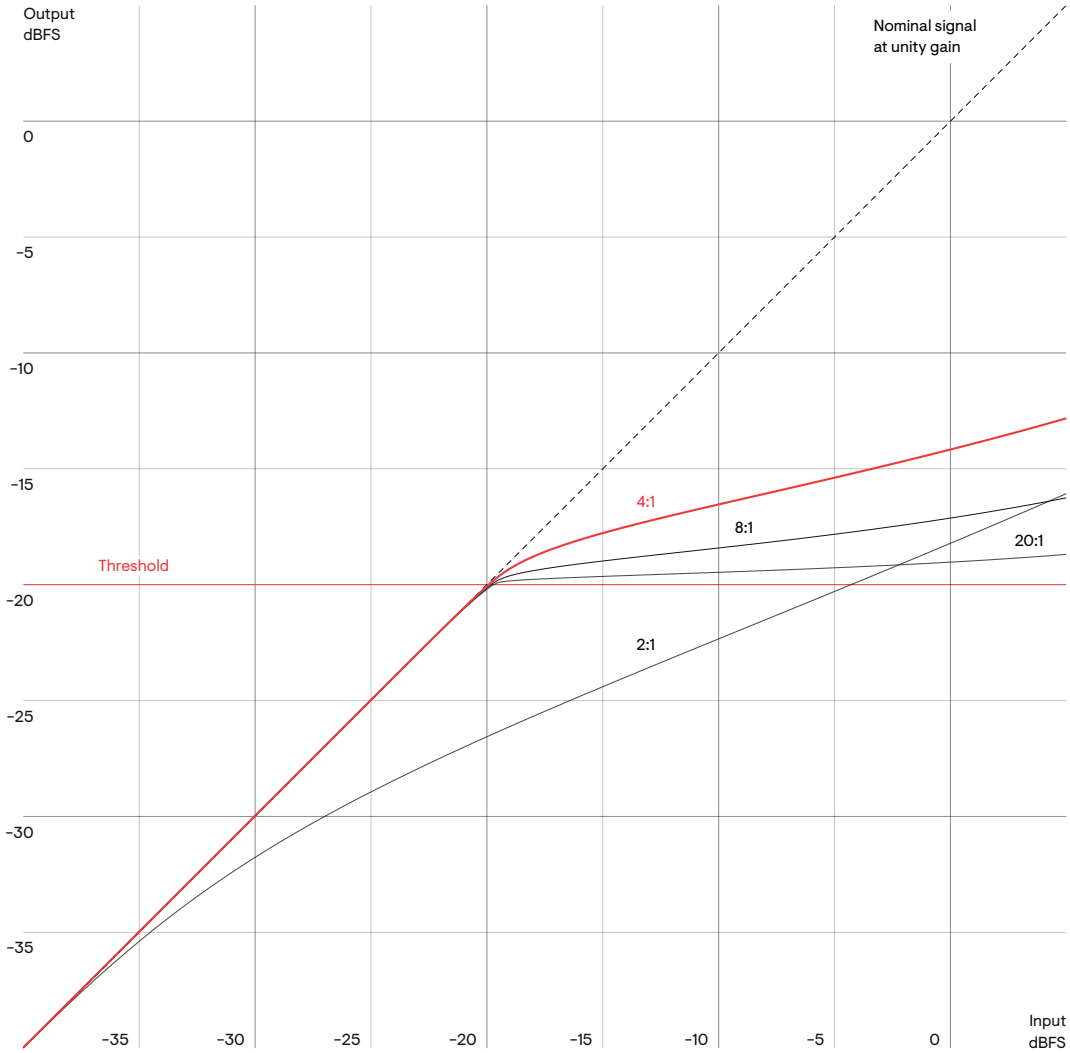


Red is 5, the middle of the dial. The output follows the input up to the corner, then bends over into a steady slope and stays on it. The other curves are the same shape slid along the line: each step of the dial lowers the corner by the same few decibels, and the slope above it stays where Ratio put it. Near the bottom of the dial only the loudest moments are touched; near the top L4 works on almost everything you send it. That keeps the two big decisions apart: Threshold says where, Ratio says how hard, and turning Threshold never changes the slope Ratio set. Under the corner L4 simply passes the signal at unity, so a quiet passage comes through as it was played. To start, bring Threshold up from 0 until the meter shows a few decibels of reduction on average, with the occasional peak swinging further. If a source needs more than the dial gives, Input pushes it harder from the other side, and Output brings the level back.

Ratio

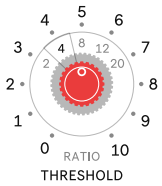


Ratio sets how firmly L4 holds the level once past the threshold. It loads at 2:1; the chart compares four of them with Threshold at 5. Five positions, but three characters rather than five.



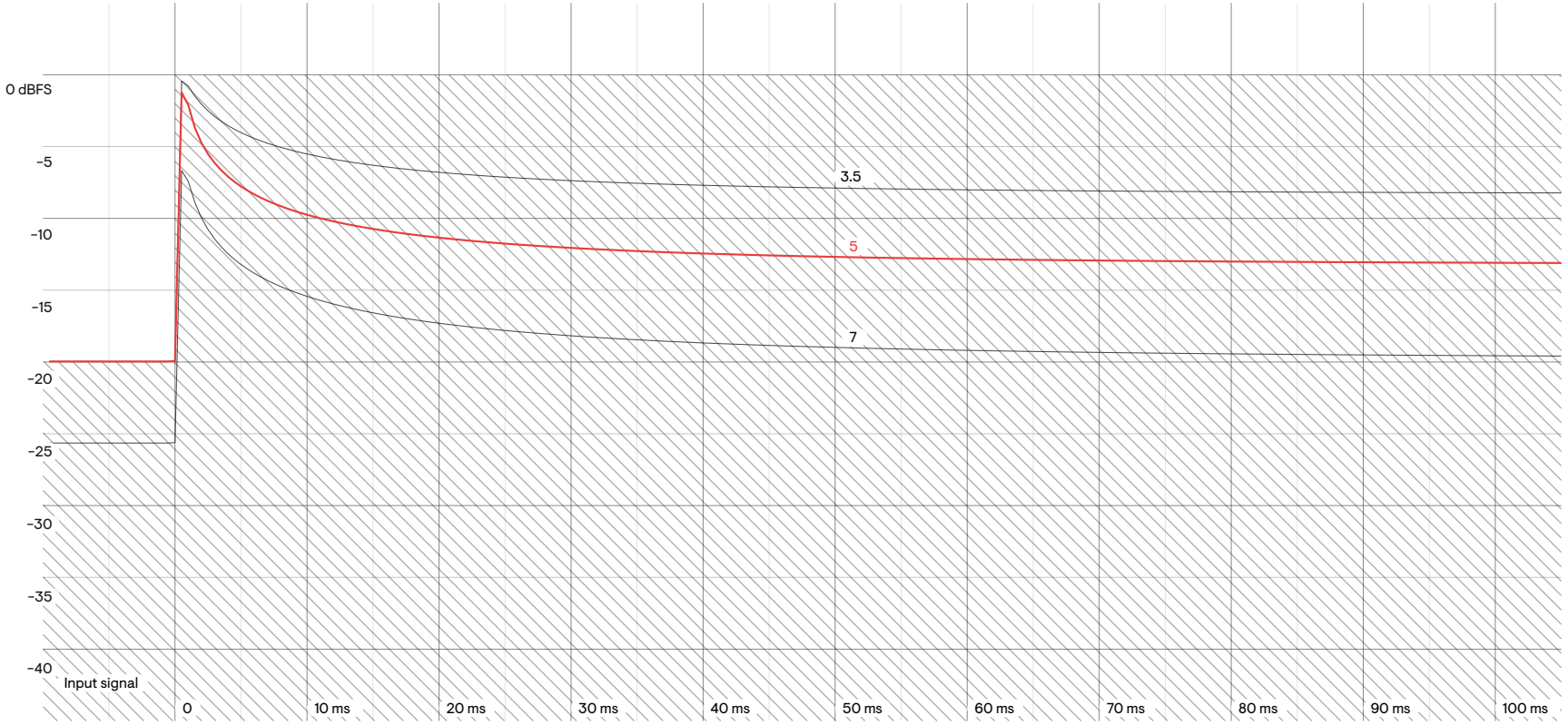
Red is 4:1, the everyday compressor: it holds the level firmly without pinning it. 8:1 starts a touch earlier and leans harder above; 12:1, not drawn, sits close between 8:1 and 20:1. 20:1 is the limiter proper, nearly flat above its corner: the body of a note passes and the peaks go hardly any further. 2:1 is a different kind of compressor. It starts much lower and its knee is wide and soft, so it touches almost everything and squeezes nothing hard: gentle, overall leveling for a group or a mix. One thing catches people out: at the same Threshold, 2:1 takes more off an everyday signal than 4:1, not less, because it starts so much earlier. Switching down for a lighter touch, bring Threshold back about three steps and the two begin in the same place.

Attack



There is no Attack dial: the light cell sets its own pace. A steady tone jumps from below the corner to full scale, and the chart follows the first moments after the step.

The cell grabs quickly but not instantly, and how deep you set it barely changes the speed. The front of every note gets through; the body is held.

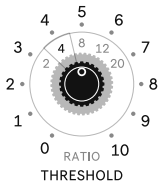


At Threshold 5 the very start is only lightly touched; most of the reduction arrives over the next few milliseconds, and the rest settles over a few dozen.

At 3.5 and 7, with less and more to do, the curves keep nearly the same pace: the timing belongs to the cell, not to the dial. Here L4 parts from L2, whose cell grabs faster the harder it works (page 18).

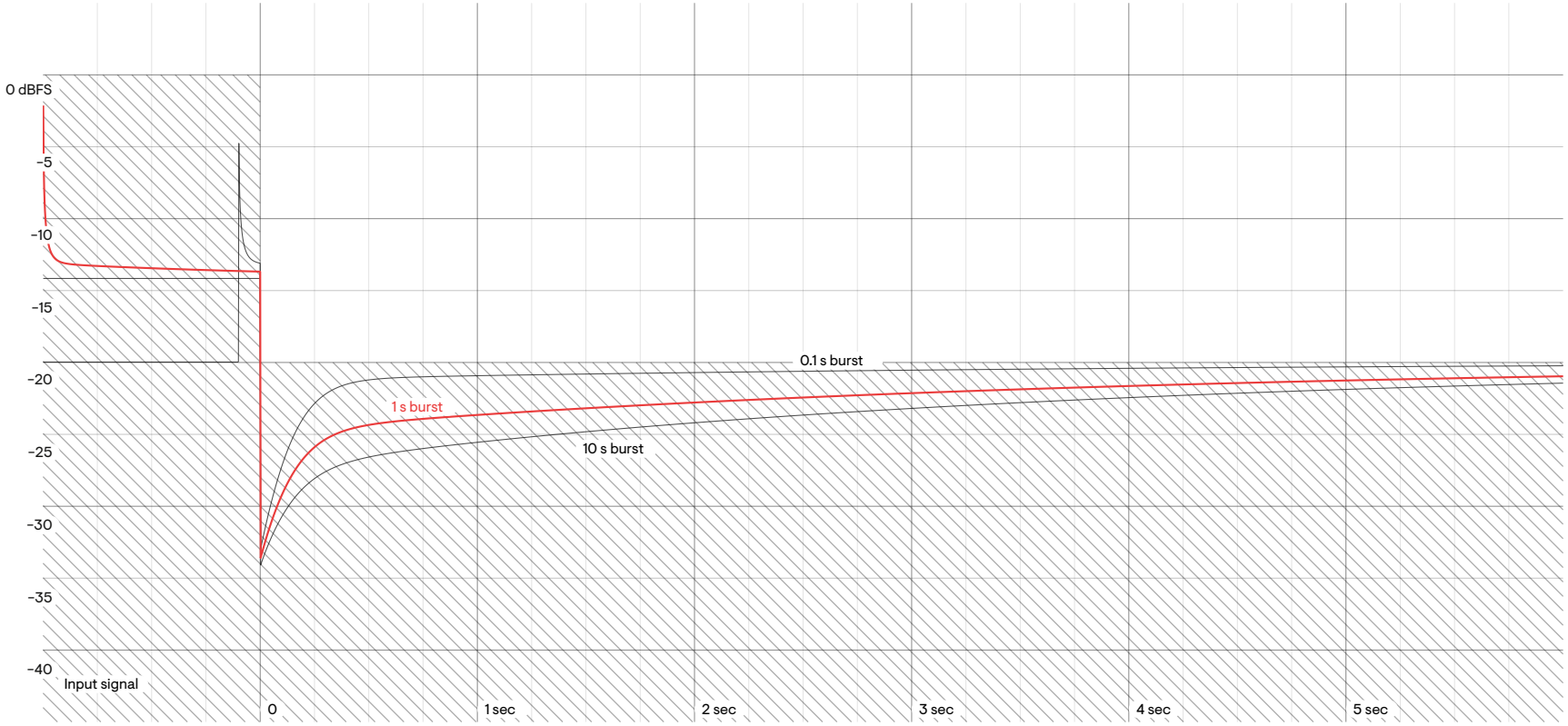
That short delay is what makes it musical: a pick, a consonant or a stick hit keeps its edge while the level behind it is caught. Where no peak may pass, follow it with a fast limiter.

Release



No Release dial either: the cell remembers. A steady tone jumps well into reduction for a short, a longer and a long burst, then drops back, and the chart follows the gain as it returns.

The release comes in two stages, as on L2 (page 19): a quick first half and a long, slow tail, and the longer the cell has been working, the longer the tail.



After the middle burst, half the reduction is gone in a fraction of a second, but the last couple of decibels take their time: the tail runs on for seconds.

A short burst barely leaves a trace and is soon home; a long one stretches the tail further still.

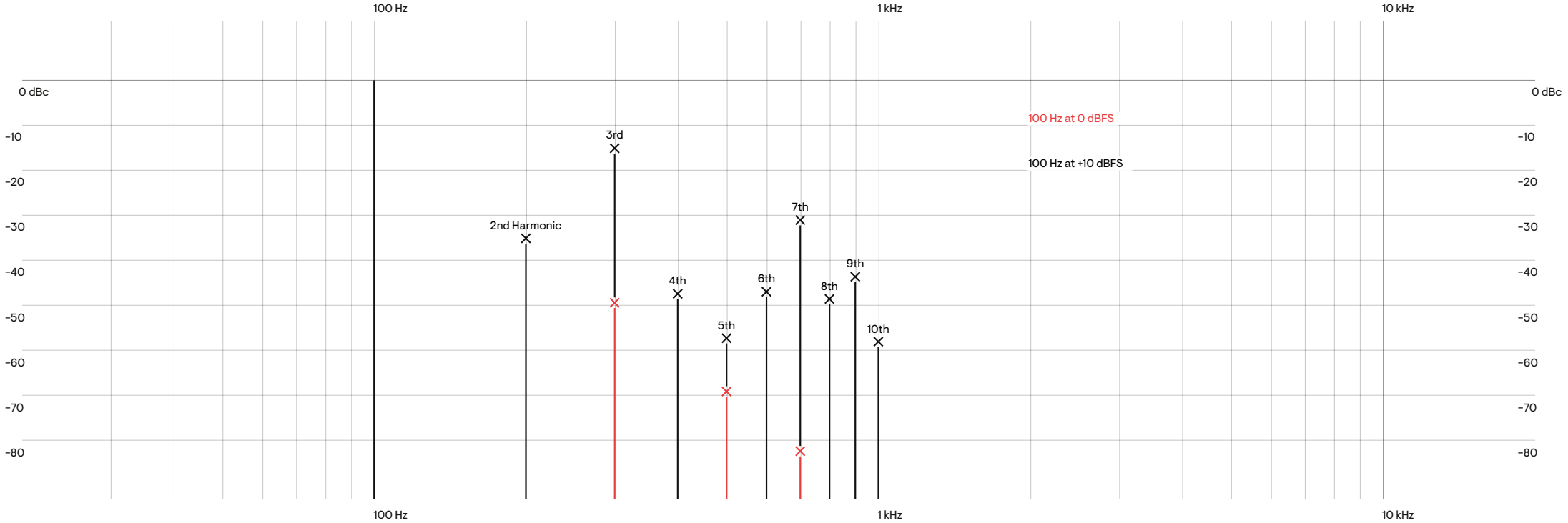
This memory is what makes L4 level rather than pump: a single hit lets go quickly, while a loud chorus leaves the gain a little down into the verse, which then eases back unnoticed. From 4:1 up, a higher ratio holds on a little longer. When the needle takes its time to come home, leave it: that tail is the sound.

Harmonics at 100 Hz

A 100 Hz tone at 0 dBFS in, +10 dBFS in black. Each cross marks a harmonic's level under the tone: −20 dBc is a tenth of it, −40 dBc a hundredth.

On a low note L4 shows what little color it has. A 100 Hz tone at Threshold 5 and 4:1, well into reduction, picks up a third harmonic with a faint fifth behind it, while the second stays out of sight: a slightly firmer bottom rather than warmth, and far less than L2 adds (page 20).

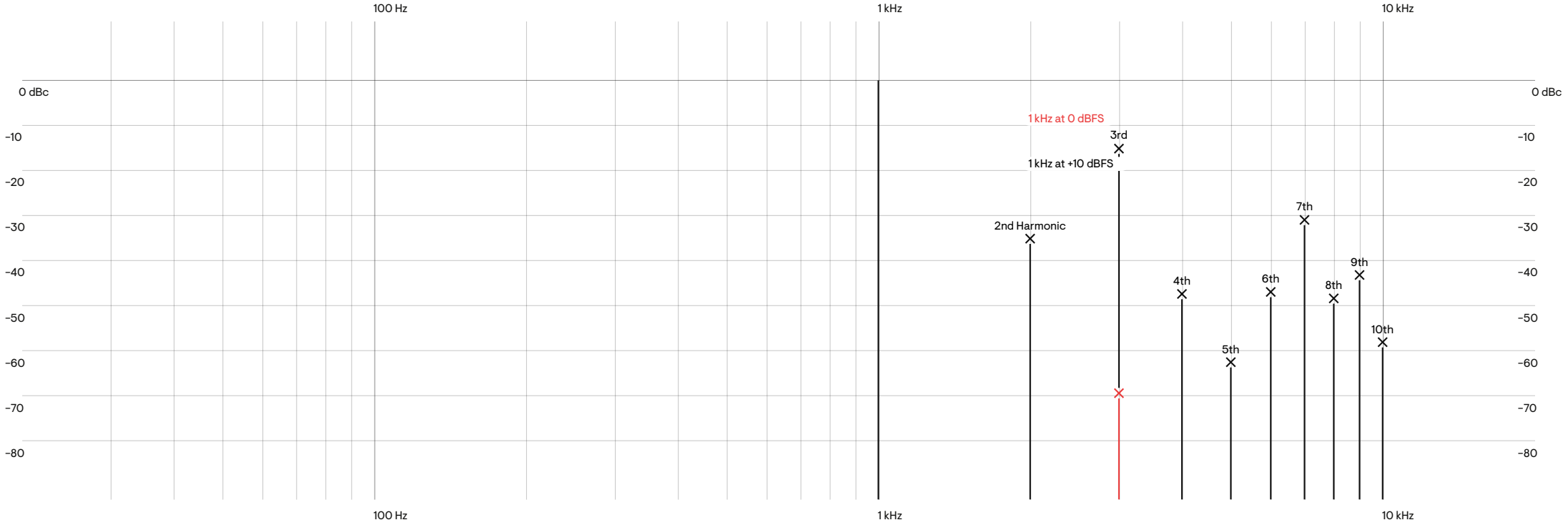
The black crosses tell a different story. Pushed that hard, the input stage clips, and a whole train of harmonics, odd and even, jumps up, the same at any pitch (next page). That is the Overload lamp's territory: take Input down and the low end returns to the quiet picture in red.



Harmonics at 1 kHz

A 1 kHz tone at 0 dBFS in, +10 dBFS in black. Each cross marks a harmonic's level under the tone: −20 dBc is a tenth of it, −40 dBc a hundredth.

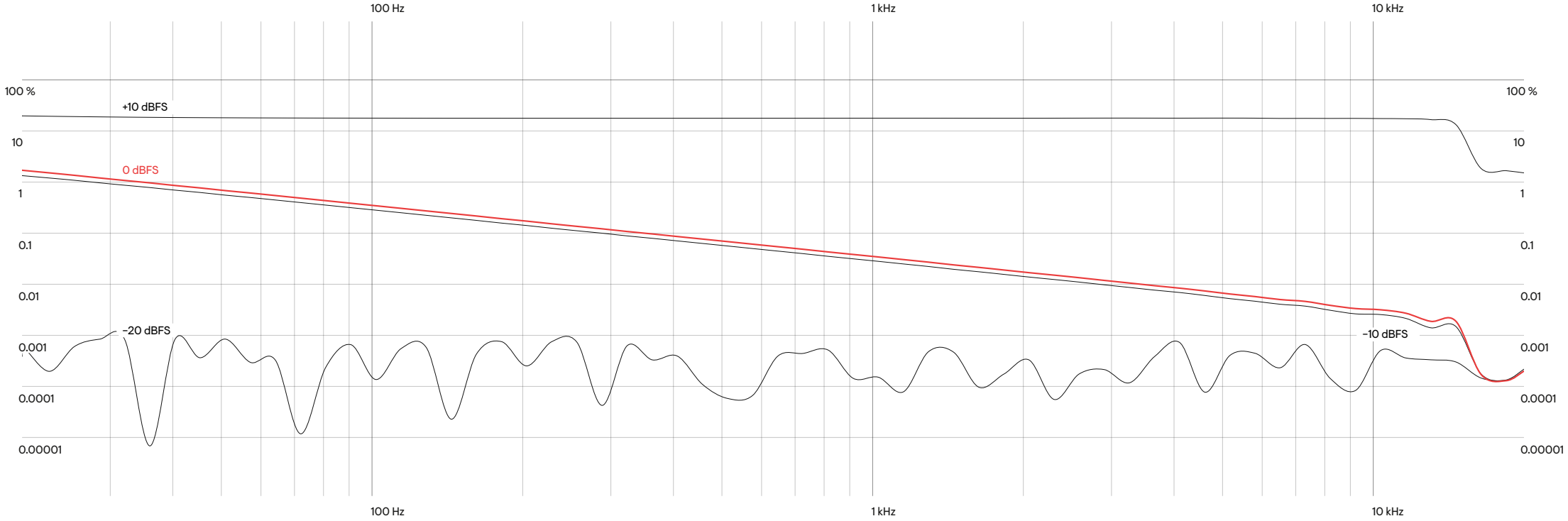
Higher up, L4 all but disappears. The red crosses are a 1 kHz tone at Threshold 5 and 4:1, deep in reduction: a third harmonic far below the tone is all that shows, the cleanest picture of the three. You hear the level being held, not the unit. The black crosses are the same tone pushed harder, into the input stage's clipping: the same full train as on the previous page, now on a midrange tone, and that is what a lit Overload lamp sounds like. Keep Input below it and L4 stays as clean as the red crosses show.



Distortion

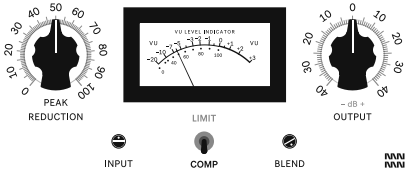
A sine at 0 dBFS in, −20, −10 and +10 dBFS in black. Higher means more distortion: at 1 % the added harmonics sit 40 dB under the tone, at 0.01 % 80 dB under.

Across the band the picture is the same, with one sharp turn at the top of the level range. A sine sweeps from the lowest bass to the top at four input levels, Threshold 5 and 4:1 throughout. Red is a full-scale sine, deep in reduction: the distortion falls steadily as the frequency rises, small in the bass and next to nothing from the mids up, so the only place it ever shows is the bottom octave of a bass. A little lower, still compressing, the curve runs just under the red one: how hard the cell works hardly changes what it adds. Under the corner L4 is clean everywhere. Pushed harder still, the whole band jumps up by orders of magnitude. That is not the compressor but the input stage running out of room, and the Overload lamp is there to warn you first. When it lights, take Input down and make the level up with Output; below it L4 stays as clean as these curves show.



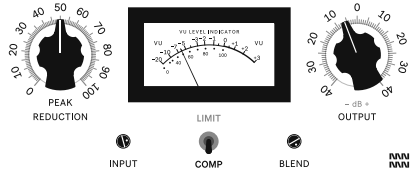
Setup Examples

On all three, set the amount by the meter, then match the level with Output. “Most users agree that optical compression is perfect for vocals, bass and guitars,” as Eddie Ciletti put it. Where an engineer is named, the hardware is theirs and the setting ours.



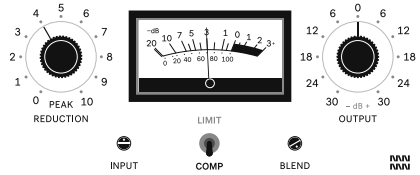
LEAD VOCAL

Optocomp L2 in Compress, Peak Reduction until the meter swings 4 to 8 dB on the phrases: the original manual’s advice for continuous use. Kevin Killen recorded Elvis Costello’s vocal on Painted From Memory, his album with Burt Bacharach, through an LA-2A. The voice stays level and keeps its shape.



BASS

Optocomp L2. Get the gain reduction in place with Peak Reduction, then turn Input up until it growls and bring Output back. That is Kevin Guarnieri’s LA-2A recipe for bass, “crank up the input until it growls”; for Rik Pekkonen it simply gives “a warmer tube sound.” The notes even out and fill the bottom.



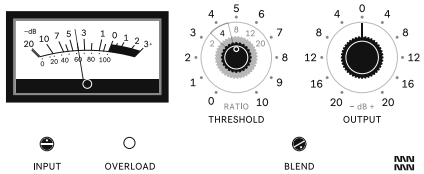
DRUM BUS

Optocomp L3 on the drums, SC Link on Stereo, Peak Reduction until the meter moves 2 to 4 dB on the hits. It grabs gently, so the sticks keep their snap as the kit pulls together. Recording Prince live at First Avenue for Purple Rain, David Z recalls, LA-3As went mainly on drums and vocals that grew louder as the show built.



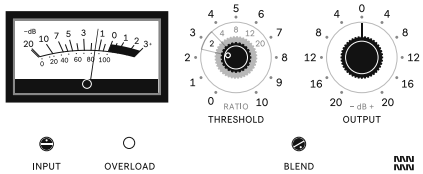
VOCAL, PINNED IN PARALLEL

Optocomp L3, Peak Reduction up until the meter is pinned and Blend back to about 50 %. Tom Lord-Alge, to make a vocal command attention, will “put it through an LA-3A and maybe pummel it with 20dB of compression, so the meter is pinned down.” Blend keeps the natural voice under the squeezed copy, which fills every gap.



ACOUSTIC GUITAR

Optocomp L4 at 4:1. Threshold up from 0 until the meter shows 3 to 5 dB on average, with the odd peak swinging further: the setup the original manual gives for any source. The strumming evens out, each pick keeps its edge, and the top end comes through untouched.



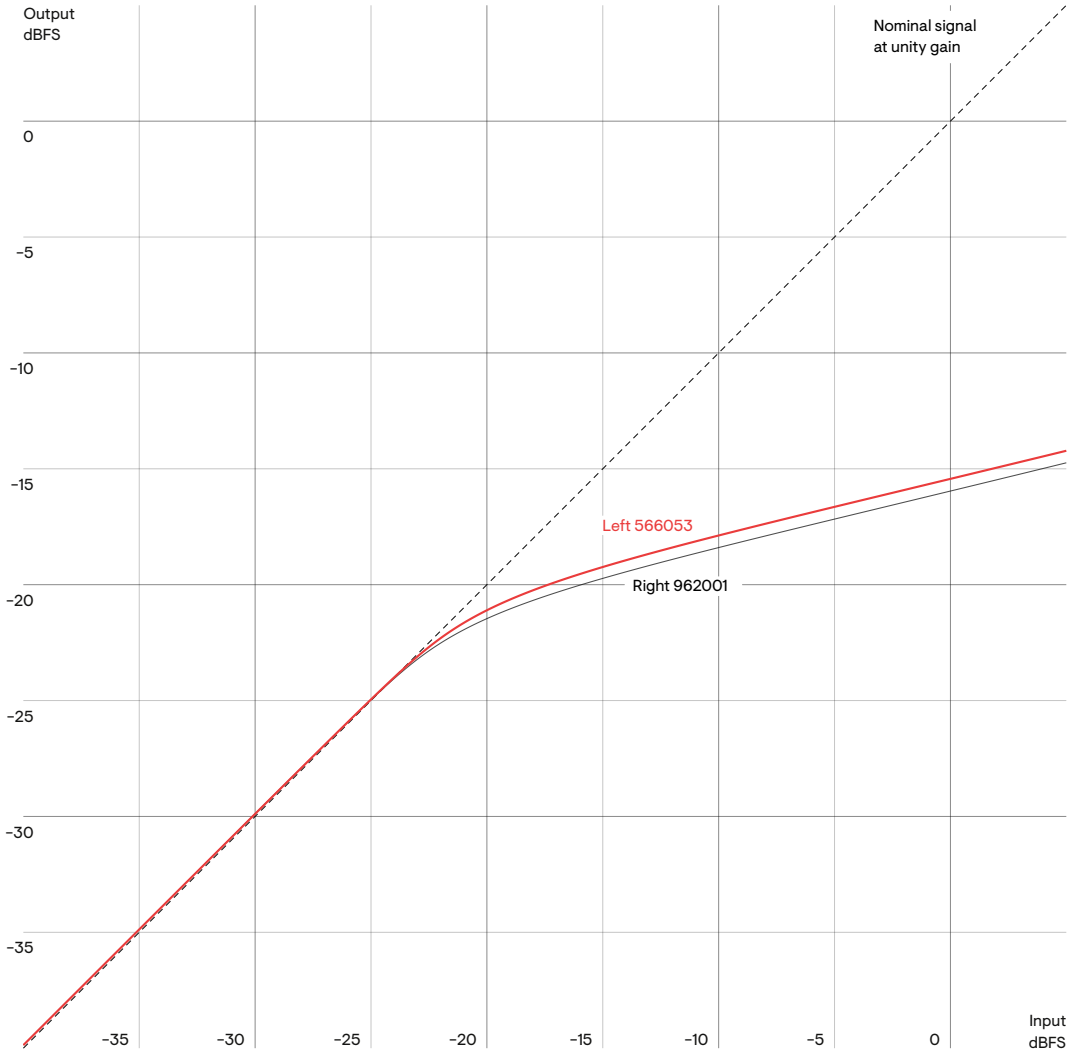
MIX BUS, GENTLY

Optocomp L4 on the mix bus, SC Link on Stereo. It loads at 2:1, its softest ratio; bring Threshold up until the needle moves a decibel or two. This is what the original manual calls gentle, overall dynamic range compression: nothing is squeezed, the mix simply sits a little closer together, and the slow tail of the release keeps it from pumping.

Serial Numbers

Every channel of Optocomp is one unit, named by the six-digit serial number on its back. The number builds that unit from its own parts, so no two units compress quite alike. Click the logo, bottom right, to see them.

Optocomp L2, a random pair: Left in red, Right in black, further apart than nine pairs in ten.



On Optocomp L2 and L3 the number draws the light cell: how sensitive its photocells are, how readily its panel glows, how quickly it lets go, how it starts from rest and how much color it adds. On L4 it draws the LED and its photocell: how strongly they couple, how quickly they let go, how they start from rest, and its factory threshold trim. The differences show once it compresses: a slightly different knee, a slightly different tail.

Set Random, the upper icon at the top of the strip, gives the two channels unrelated numbers, and that is where the units part. The chart shows such a pair on L2, SC Link on Dual Mono: one unit reaches the knee a little earlier and holds back a little more above it, the other starts later and lets more through. Most random pairs part only a little; one in ten parts as far as the chart shows. On a stereo source that is a touch of width, and two sides that let go differently after the same phrase.

Set Stereo, the lower icon, gives a random pair of consecutive numbers, a matched pair from the same batch, and they stay very close. The defaults are such a pair: 482913 and 482914 on L2, 330705 and 330706 on L3, 440417 and 440418 on L4.

SC Link on Stereo gives both channels the same reduction, and the image holds still. Leave it on Dual Mono, the default, to hear the two units.

Under The Hood

Three devices modeled on three optical compressors: the tube LA-2A, the solid-state LA-3A of 1969 and the LA-4 of 1976

Each built from its factory drawing into a complete circuit model, part by part. All three are checked against their models end to end

A serial number for each channel, each its own light cell and part tolerances. Consecutive numbers make a matched pair

Inside, the audio path runs at twice the host rate, to keep aliasing down when pushed

Each light cell modeled with its memory: the longer it works, the slower it lets go

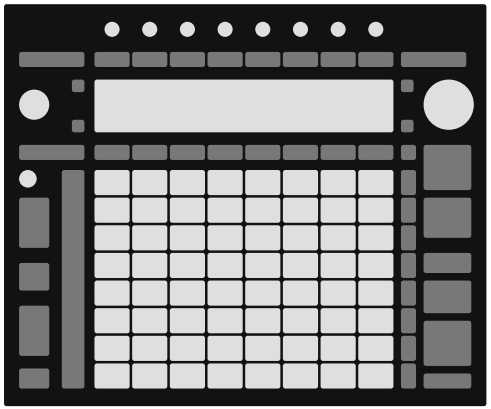
31 samples of latency, reported to Live: about 0.65 ms at 48 kHz. Blend's dry signal is delayed to match, so parallel compression never combs

Each meter a model of a VU movement, reading gain reduction only

Added to the original circuits: Input, Blend, a sidechain high-pass and high shelf. SC Link is the originals' stereo strapping

By our count about 5 % (L2), 9 % (L3) and 3 % (L4) of a core while compressing

0 dBFS is +16 dBu at the input and output of all three



PUSH BANKS: COMPRESSOR, GLOBAL AND SETTINGS

OPTOCOMP REQUIRES LIVE WITH MAX FOR LIVE

A personal note

Thank you so much for checking out my work. I hope it helps you explore and learn these tools. I would never claim great expertise in audio engineering, but through my love for this craft I hope to shed a bit of light on it. I'm always happy to share what I know, and I'd especially love to hear your thoughts on the result. Please don't hesitate to reach out with questions, concerns, feedback or anything else.

You can reach me at info@monomono.audio, or send me a message on Instagram at @monomono.audio. I handle all my communication myself and will be happy to hear from you.

Oh, and while the research and proofreading were done with the help of various language models, every single em dash in this manual was put in by hand. Decades of print-design experience still leak through in my copy.

— Nikita

Including this one. It's ⌥+⇧+-. You're welcome.

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The people quoted or credited in this manual are quoted from the published sources below. Their words describe the original hardware, not Optocomp, and no endorsement by them is claimed or implied.

Jim Lawrence: US Patent 3,258,707, 1966; Journal of the SMPTE, August 1964.

Bill Putnam: United & Affiliates Newsletter, July 1967; UREI, LA-2A manual, 1992.

Brad Plunkett: United & Affiliates Newsletter, December 1969.

Eddie Ciletti: Tape Op, May 2002.

Kevin Killen: Gearspace, 2007.

Kevin Guarnieri and Rik Pekkonen: Mix, Maureen Droney, August 2004.

David Z: Mix, Dan Daley, January 2009.

Tom Lord-Alge: Sound On Sound, Mike Senior, September 2009.

The history draws on factory documents of the period and photographs of original units. None of the people above reviewed or endorsed Optocomp.

Release Notes

1.0 — November 23, 2026 Initial Release