CAUSAL DECODING · REAL KV CACHES · CONVOLUTION HISTORIES

Small packets. Keep the memory.

Do transformer states repair tiny decoding windows? A paired decoder-only experiment separates attention history, convolution state, replayed context, and waveform overlap-add.

2 causal codecs · 60 source clips · 10,950 measured conditions · complete

Independent experiment validation: passed. See the downloadable validation artifact for measured geometry, source/code/checkpoint hashes, numerical control limits and complete-state equivalence checks.

The question, precisely

Fish S2-Pro and Qwen3-TTS Tokenizer 12Hz contain causal codec transformers, but their waveform decoders also need convolutional history. The same full-source tokens, every codebook, checkpoint and 60 speech clips are kept fixed; only decoder execution and assembly change. This is not a benchmark of their text-to-speech language models.

> Percentages below mean **changes in spectral error relative to full decoding**. They are not MOS, WER or a percentage of audible quality lost. Complete decoder state can recover full-decoder behavior without removing the codec’s underlying quantization loss.

What the complete experiment shows

Fish S2-Pro codec

Complete state supports the smallest tested hard packet: **1 token frame (46.4 ms)**, with +0.00% added log-mel error across 60 clips. Across all 1,134 complete-state hard/overlap conditions, the largest waveform drift was 2.871e-07 RMS and 1.333e-05 peak.

At the fixed eight-frame comparison, reset hard joins add +92.16% log-mel error; KV only adds +18.32%, convolution state only +73.91%, and complete state +0.00%. Hann50 changes reset to +74.46% and KV only to +3.93%; complete state with Hann50 is +0.00%.

Qwen3-TTS Tokenizer 12Hz

Complete state supports the smallest tested hard packet: **1 token frame (80.0 ms)**, with +0.00% added log-mel error across 60 clips. Across all 1,056 complete-state hard/overlap conditions, the largest waveform drift was 2.432e-07 RMS and 2.676e-05 peak.

At the fixed eight-frame comparison, reset hard joins add +37.27% log-mel error; KV only adds +11.11%, convolution state only +23.44%, and complete state +0.00%. Hann50 changes reset to +28.70% and KV only to +1.36%; complete state with Hann50 is +0.00%.

These are measured spectral-error changes, not subjective quality percentages. Eight frames correspond to different durations in the two codecs. The full tables and paired confidence intervals below retain the uncertainty and all tested sizes.

Open the interactive matched listening samples to compare the original, full decode, and any two measured state/overlap treatments.

A common eight-frame reference window

A fixed, outcome-independent eight-frame view compares every method at the same token width. This is approximately 372 ms for Fish and 640 ms for Qwen, so the window is not duration-matched across codecs. Reduction is paired against reset hard joins at that width; original-source spectral error and drift from the full decoder are different quantities.

Codec	State + assembly	Clips	Added log-mel error	95% CI	Error reduction vs reset hard	Full-waveform drift RMS
Fish S2-Pro codec	All state · Hann 50%	60	+0.00%	-0.00% to +0.00%	+47.96%	9.514e-08
Fish S2-Pro codec	All state · hard joins	60	+0.00%	-0.00% to +0.00%	+47.96%	9.989e-08
Fish S2-Pro codec	Conv only · Hann 50%	60	+72.38%	+65.64% to +80.04%	+10.29%	0.06452
Fish S2-Pro codec	Conv only · hard joins	60	+73.91%	+67.02% to +81.52%	+9.50%	0.06803
Fish S2-Pro codec	KV only · Hann 50%	60	+3.93%	+3.41% to +4.46%	+45.92%	0.005712
Fish S2-Pro codec	KV only · hard joins	60	+18.32%	+16.98% to +19.79%	+38.43%	0.02101
Fish S2-Pro codec	Reset · Hann 50%	60	+74.46%	+67.74% to +81.85%	+9.21%	0.06443
Fish S2-Pro codec	Reset · hard joins	60	+92.16%	+85.13% to +99.74%	—	0.06928
Fish S2-Pro codec	Replay 32 · Hann 50%	60	+14.48%	+12.09% to +16.96%	+40.43%	0.02767
Fish S2-Pro codec	Replay 32 · hard joins	60	+15.19%	+12.58% to +17.92%	+40.06%	0.02845
Qwen3-TTS Tokenizer 12Hz	All state · Hann 50%	60	+0.00%	-0.00% to +0.00%	+27.15%	8.076e-08
Qwen3-TTS Tokenizer 12Hz	All state · hard joins	60	+0.00%	-0.00% to +0.00%	+27.15%	8.057e-08
Qwen3-TTS Tokenizer 12Hz	Conv only · Hann 50%	60	+25.60%	+22.98% to +28.35%	+8.50%	0.03448
Qwen3-TTS Tokenizer 12Hz	Conv only · hard joins	60	+23.44%	+20.96% to +26.07%	+10.08%	0.03607
Qwen3-TTS Tokenizer 12Hz	KV only · Hann 50%	60	+1.36%	+1.11% to +1.61%	+26.16%	0.004741
Qwen3-TTS Tokenizer 12Hz	KV only · hard joins	60	+11.11%	+10.07% to +12.19%	+19.06%	0.02066

Codec	State + assembly	Clips	Added log-mel error	95% CI	Error reduction vs reset hard	Full-waveform drift RMS
Qwen3-TTS Tokenizer 12Hz	Reset · Hann 50%	60	+28.70%	+25.54% to +31.94%	+6.25%	0.0363
Qwen3-TTS Tokenizer 12Hz	Reset · hard joins	60	+37.27%	+33.70% to +41.19%	—	0.04332
Qwen3-TTS Tokenizer 12Hz	Replay 32 · Hann 50%	60	+2.55%	+1.84% to +3.38%	+25.29%	0.007911
Qwen3-TTS Tokenizer 12Hz	Replay 32 · hard joins	60	+2.65%	+1.89% to +3.57%	+25.22%	0.008084

Complete-state equivalence and practical ranges

These are the largest measured disagreements against each codec's genuine full decode over all completed all-state hard and overlap conditions—not an average that could conceal one failed clip. Values are reported in waveform amplitude units after the common-rate scoring path. Cache storage includes retained attention and convolution state, not model weights, activations or temporary rollback snapshots.

Codec	Measured all-state conditions	Largest waveform RMS drift	Largest waveform peak drift	Largest retained state storage
Fish S2-Pro codec	1134	2.871e-07	1.333e-05	8.485 MiB
Qwen3-TTS Tokenizer 12Hz	1056	2.432e-07	2.676e-05	4.977 MiB

Every complete-state condition is checked against the predeclared waveform bounds: peak drift ≤ 0.0001 and RMS drift ≤ 5e-06. These are numerical correctness bounds, not human audibility thresholds.

▼ Complete-state log-mel error and confidence interval at every tested width

Codec	Window	Paired clips	All-state added log-mel error	Pointwise 95% CI
Fish S2-Pro codec	1 frames	60	+0.00%	-0.00% to +0.00%
Fish S2-Pro codec	2 frames	60	+0.00%	-0.00% to +0.00%
Fish S2-Pro codec	4 frames	60	+0.00%	-0.00% to +0.00%
Fish S2-Pro codec	8 frames	60	+0.00%	-0.00% to +0.00%
Fish S2-Pro codec	12 frames	60	+0.00%	-0.00% to +0.00%
Fish S2-Pro codec	16 frames	60	-0.00%	-0.00% to +0.00%
Fish S2-Pro codec	24 frames	60	+0.00%	-0.00% to +0.00%
Fish S2-Pro codec	32 frames	60	+0.00%	-0.00% to +0.00%
Fish S2-Pro codec	48 frames	59	+0.00%	-0.00% to +0.00%
Fish S2-Pro codec	64 frames	58	-0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	1 frames	60	+0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	2 frames	60	+0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	4 frames	60	+0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	8 frames	60	+0.00%	-0.00% to +0.00%

Codec	Window	Paired clips	All-state added log-mel error	Pointwise 95% CI
Qwen3-TTS Tokenizer 12Hz	12 frames	60	+0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	16 frames	60	-0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	24 frames	60	+0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	32 frames	58	+0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	48 frames	50	-0.00%	-0.00% to +0.00%
Qwen3-TTS Tokenizer 12Hz	64 frames	30	-0.00%	-0.00% to +0.00%

Smallest tested window below joint 5% and 50% added-error budgets

A joint pass requires the upper pointwise 95% confidence bound for all three source spectral metrics to satisfy the budget at this and every larger eligible measured width, with all 60 clips included. The result is a conservative tested-grid threshold, not an exact minimum over unseen widths. “Not established” does not mean every window fails.

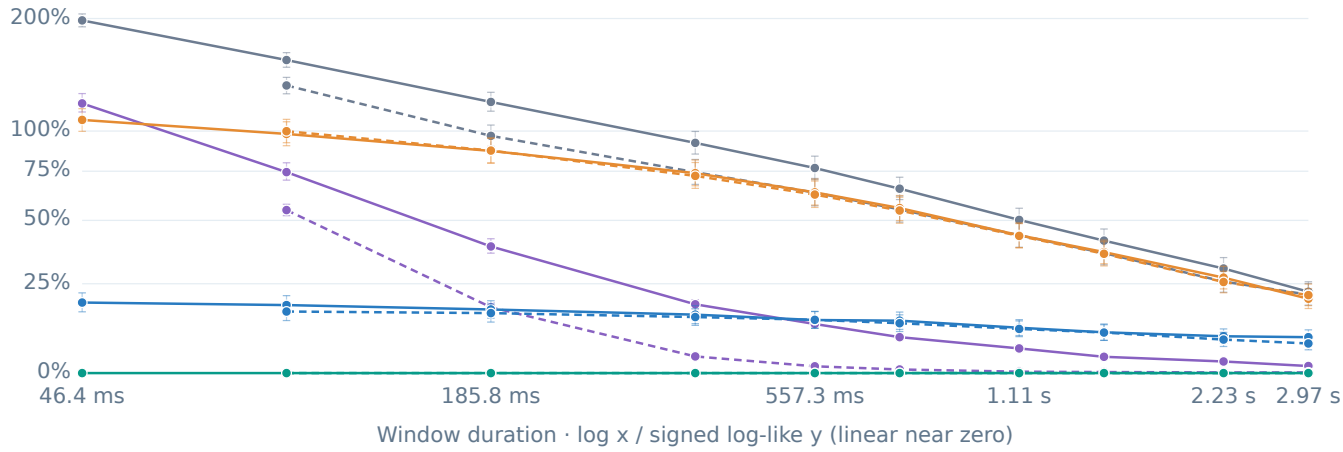
Codec	State + assembly	Joint 5% error budget	Joint 50% error budget
Fish S2-Pro codec	Reset · hard joins	Not established	Not established
Fish S2-Pro codec	Reset · Hann 50%	Not established	Not established
Fish S2-Pro codec	KV only · hard joins	Not established	8 frames · 371.5 ms
Fish S2-Pro codec	KV only · Hann 50%	8 frames · 371.5 ms	4 frames · 185.8 ms
Fish S2-Pro codec	Conv only · hard joins	Not established	Not established
Fish S2-Pro codec	Conv only · Hann 50%	Not established	Not established
Fish S2-Pro codec	All state · hard joins	1 frames · 46.4 ms	1 frames · 46.4 ms
Fish S2-Pro codec	All state · Hann 50%	2 frames · 92.9 ms	2 frames · 92.9 ms
Fish S2-Pro codec	Replay 32 · hard joins	Not established	1 frames · 46.4 ms
Fish S2-Pro codec	Replay 32 · Hann 50%	Not established	2 frames · 92.9 ms
Qwen3-TTS Tokenizer 12Hz	Reset · hard joins	Not established	16 frames · 1280.0 ms
Qwen3-TTS Tokenizer 12Hz	Reset · Hann 50%	Not established	12 frames · 960.0 ms
Qwen3-TTS Tokenizer 12Hz	KV only · hard joins	Not established	4 frames · 320.0 ms
Qwen3-TTS Tokenizer 12Hz	KV only · Hann 50%	8 frames · 640.0 ms	4 frames · 320.0 ms
Qwen3-TTS Tokenizer 12Hz	Conv only · hard joins	Not established	8 frames · 640.0 ms
Qwen3-TTS Tokenizer 12Hz	Conv only · Hann 50%	Not established	12 frames · 960.0 ms
Qwen3-TTS Tokenizer 12Hz	All state · hard joins	1 frames · 80.0 ms	1 frames · 80.0 ms
Qwen3-TTS Tokenizer 12Hz	All state · Hann 50%	2 frames · 160.0 ms	2 frames · 160.0 ms
Qwen3-TTS Tokenizer 12Hz	Replay 32 · hard joins	12 frames · 960.0 ms	1 frames · 80.0 ms
Qwen3-TTS Tokenizer 12Hz	Replay 32 · Hann 50%	12 frames · 960.0 ms	2 frames · 160.0 ms

The architecture we actually measured

Installed codec	Active decode transformer	Temporal code rate	Codebooks	Important source audit finding
Fish S2-Pro	Quantizer post-transformer: 8 layers, 128-position causal window; 127 historical KV positions/layer.	21.533203125 Hz · 2048 samples at 44.1 kHz	10	The apparently configured decoder transformer is constructed but omitted from the active Sequential path. The paper's EVA-GAN description differs from the pinned installed Decoder implementation; we do not substitute a different architecture.
Qwen3-TTS Tokenizer 12Hz	Pre-transformer: 8 layers, 72-position causal window; 71 historical KV positions/layer.	12.5 Hz · 1920 samples at 24 kHz	16	Causal convolution precedes attention and waveform upsampling follows it. The public chunked helper replays earlier codes; it does not retain waveform-level KV state.

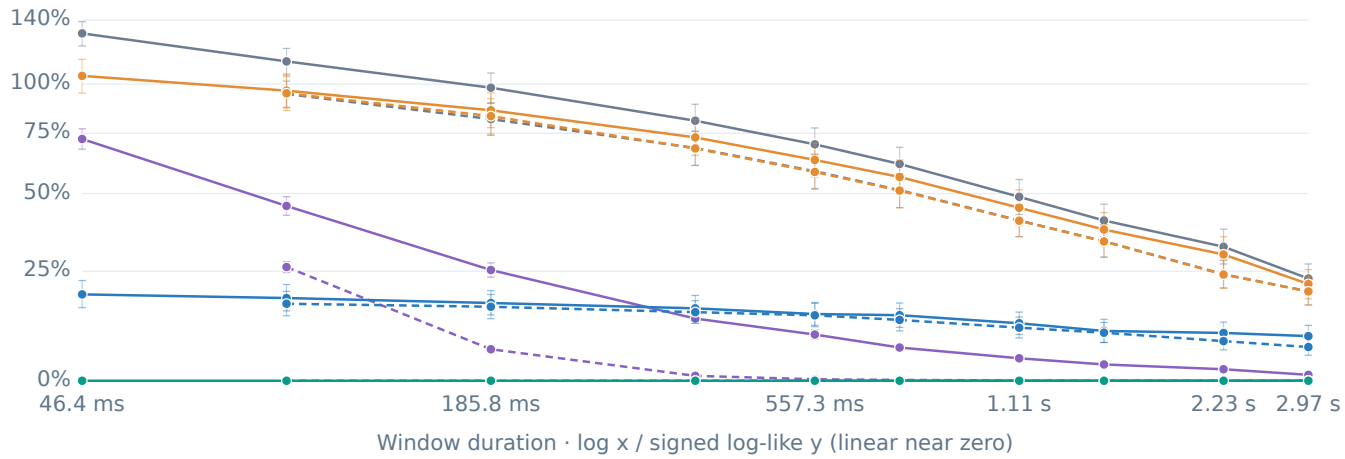
Both active attention stacks have 16 KV heads with dimension 64. Stacked attention windows are not a guarantee that replaying only one window's worth of raw codes reproduces the full decoder. Installed checkpoint/configuration pins and detailed audit evidence are in the downloads below.

Browse the paired results



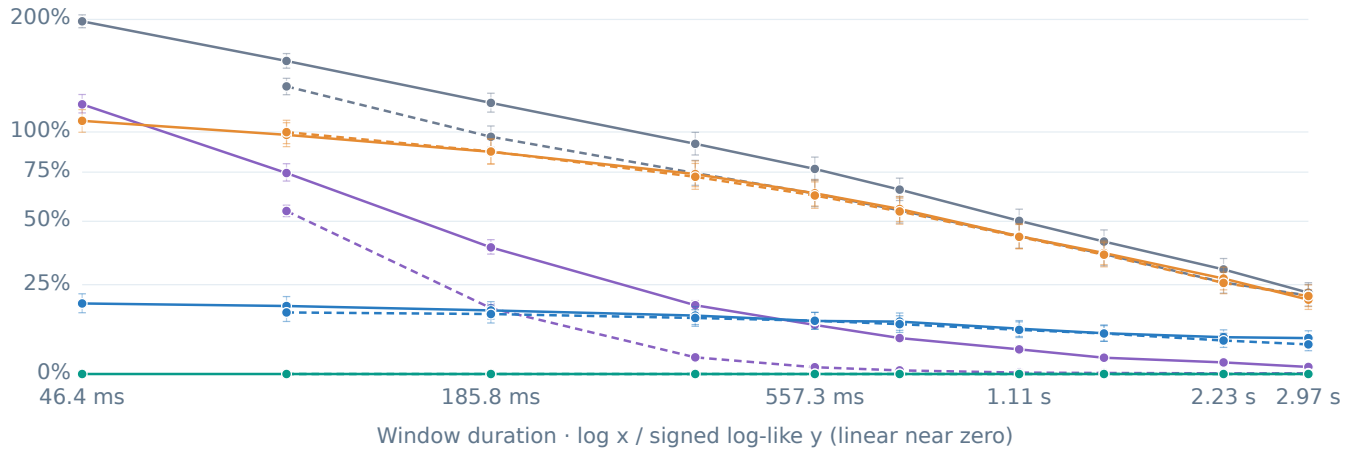
95 measured aggregate points · Experiment complete · solid = hard, dashed = Hann50 · 58–60 eligible clips per point. Long windows exclude no-seam clips; hover a point for its exact n.

Fish S2-Pro codec · MR-STFT · all measured policies



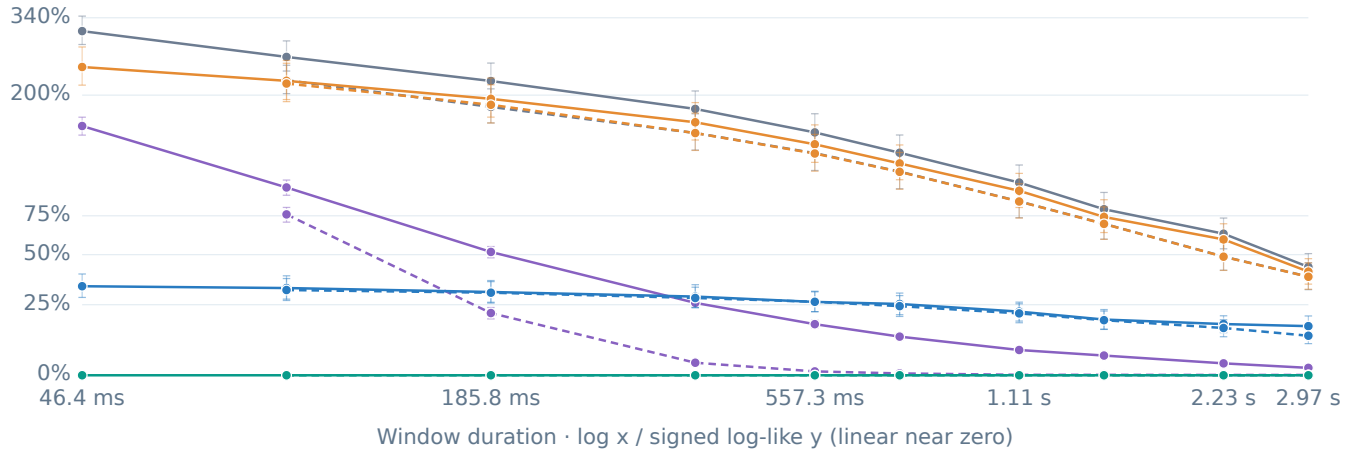
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Fish S2-Pro codec · Log-mel · all measured policies



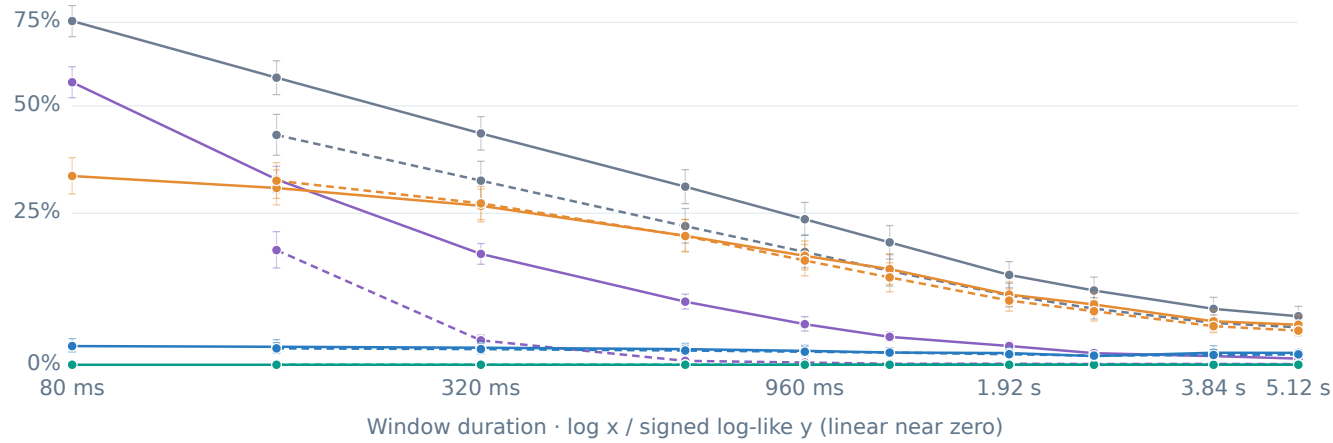
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Fish S2-Pro codec · Log1p-mel · all measured policies



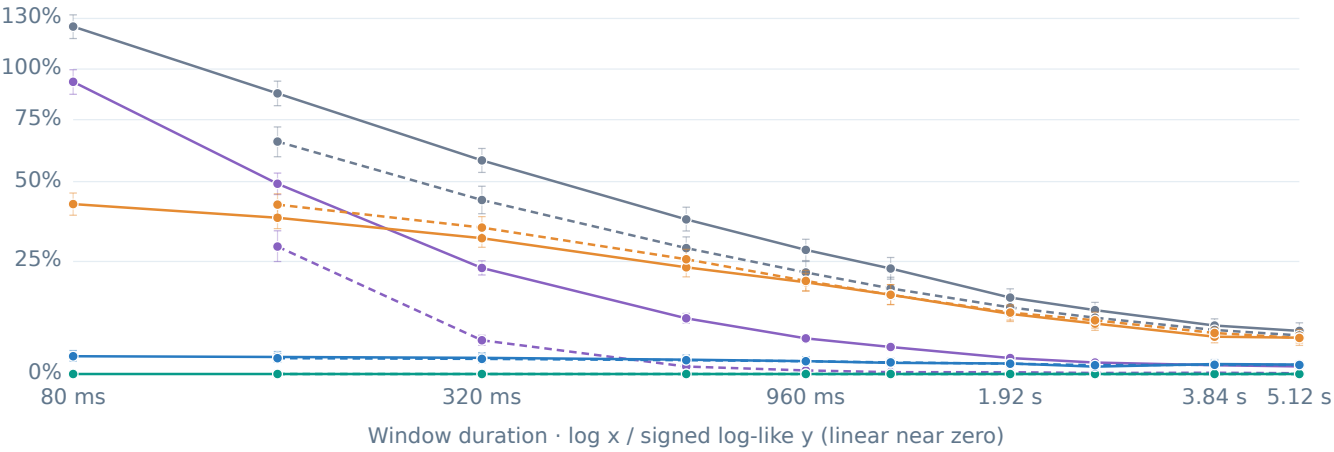
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Qwen3-TTS Tokenizer 12Hz · MR-STFT · all measured policies



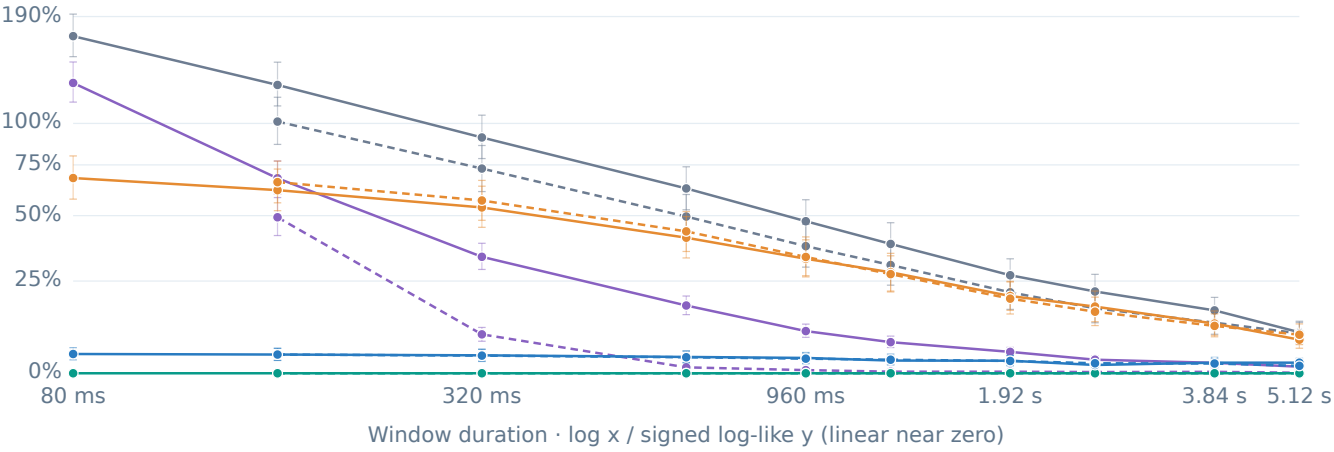
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Qwen3-TTS Tokenizer 12Hz · Log-mel · all measured policies



● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Qwen3-TTS Tokenizer 12Hz · Log1p-mel · all measured policies



● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

State, overlap and the interaction

State policy	What actually survives
Reset	No decoder history survives a window boundary.
KV only	Per-layer transformer keys/values and positions survive; convolution history resets.
Conv only	Causal convolution inputs and transposed-convolution tails survive; attention resets.
All state	Attention, convolution/upsampling history and positions survive.
Replay 32	Decode up to 32 earlier code frames again and discard their audio; this is not a KV cache.

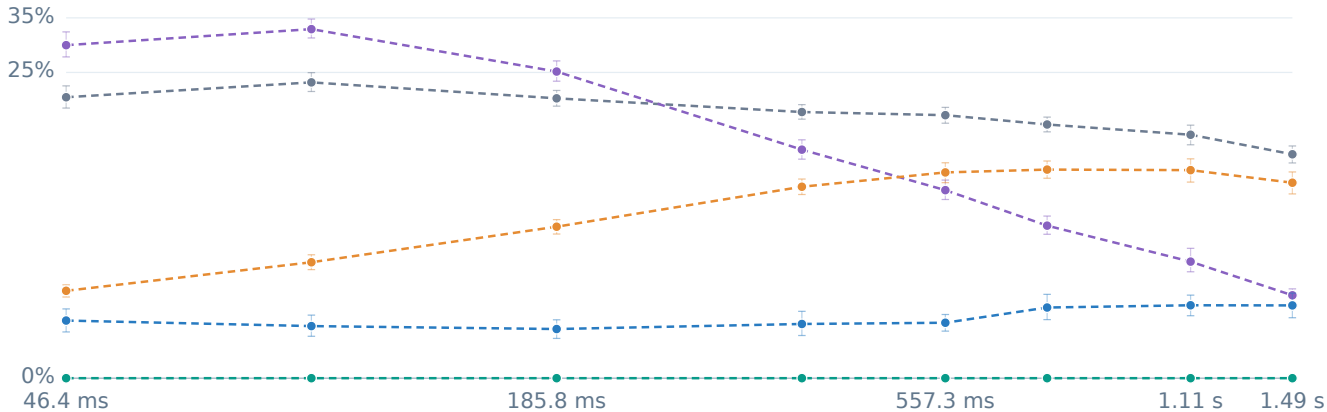
Every state policy is tested with hard concatenation and normalized Hann 50% overlap-add. One-frame windows cannot overlap at an integer stride; those combinations are unavailable, not fabricated zero-error results.

KV-only keeps the actual per-layer keys and values and global positions but resets convolution histories. Conv-only does the reverse. All-state keeps both. Replay 32 decodes up to 32 prior token frames again and drops their waveform prefix: useful context, but not a cache.

Both codecs are causal. Correct complete state should closely reproduce the native one-shot decoder, including tiny packets. Overlap should then provide little extra information. Partial-state conditions intentionally remove information; benefits and failures must be measured.

Equal newly emitted stride: a second comparison

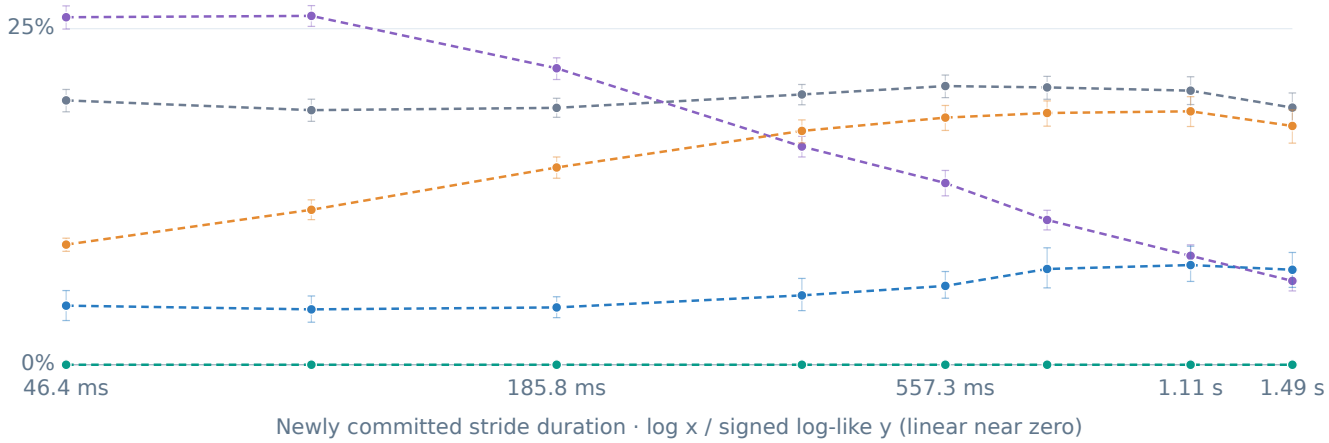
For each carried-state policy and matched clip, compare hard width S against Hann50 width 2S. Both commit S new token frames per step. The plotted quantity is 100 × (mean hard error − mean overlap error) / mean hard error, with a paired 95% interval. Only jointly measured clips and widths appear; no aggregate interpolation is used.



Newly committed stride duration · log x / signed log-like y (linear near zero)

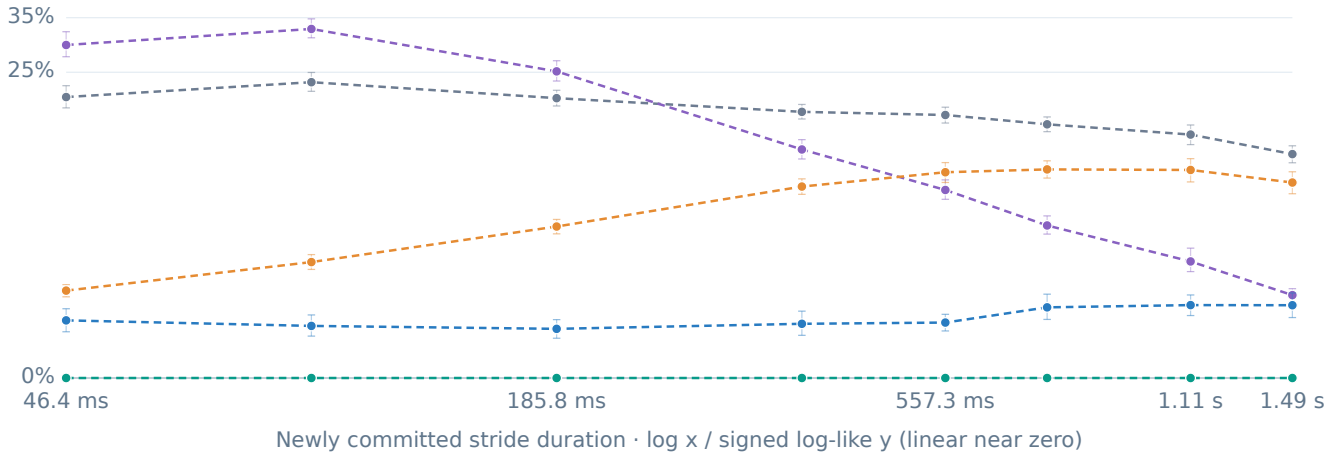
Positive values mean overlap has lower total source spectral error; negative values mean it is worse. Initial token buffering remains S for hard versus 2S for this overlap schedule, so this is not an equal-initial-latency claim. Select codec, cohort and metric in the main controls above.

Fish S2-Pro codec · MR-STFT · paired equal-stride error reduction



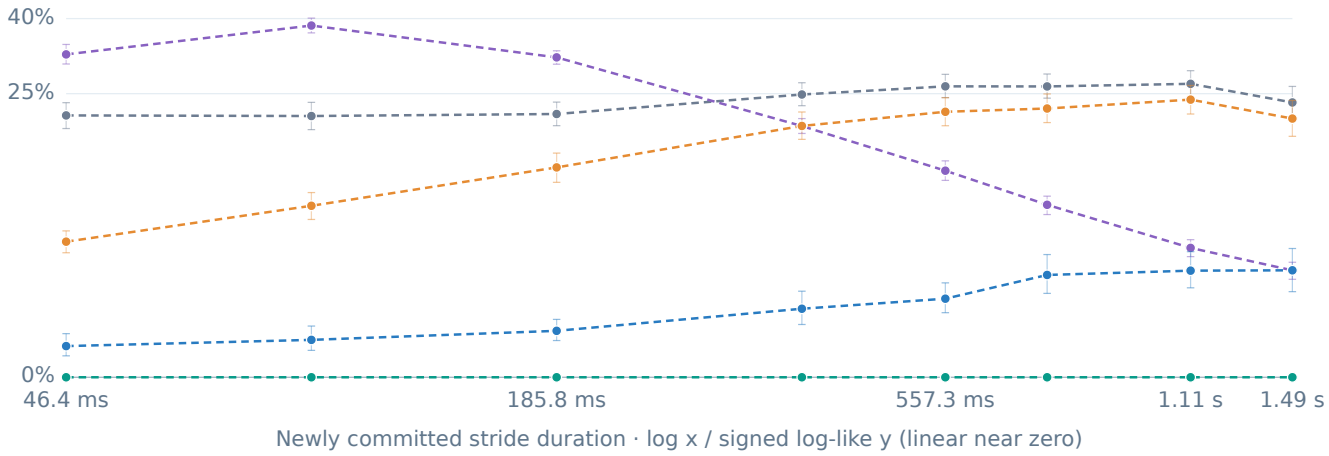
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Hann width 2S versus hard width S · equal emitted stride · positive = lower error with overlap

Fish S2-Pro codec · Log-mel · paired equal-stride error reduction



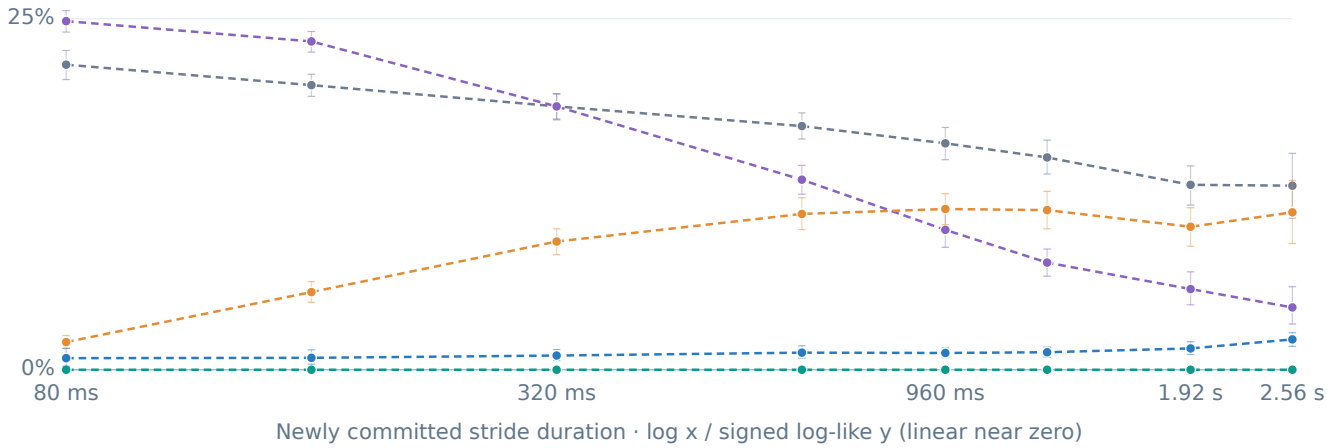
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Hann width 2S versus hard width S · equal emitted stride · positive = lower error with overlap

Fish S2-Pro codec · Log1p-mel · paired equal-stride error reduction



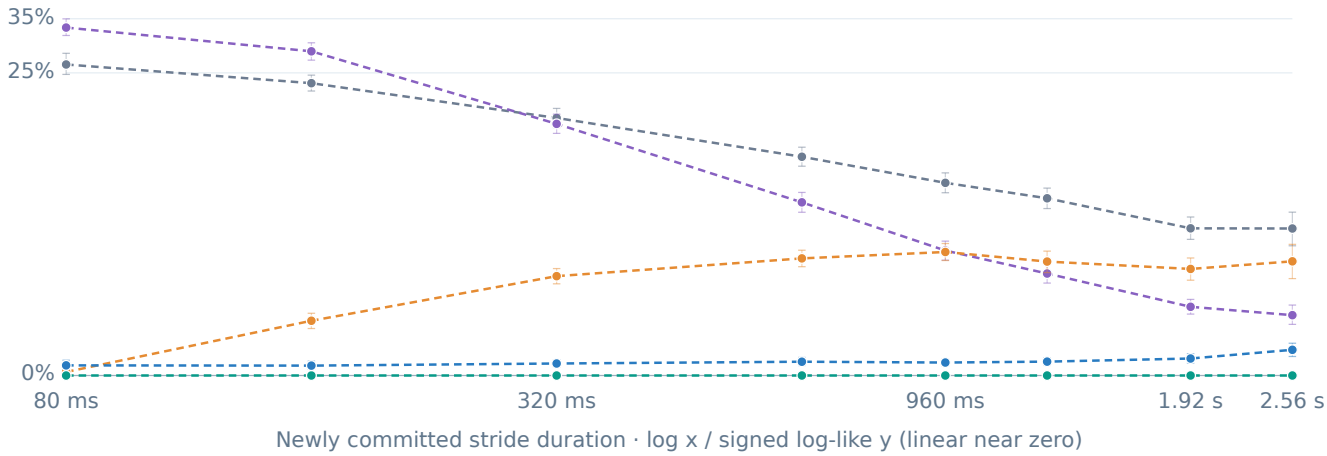
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Hann width 2S versus hard width S · equal emitted stride · positive = lower error with overlap

Qwen3-TTS Tokenizer 12Hz · MR-STFT · paired equal-stride error reduction



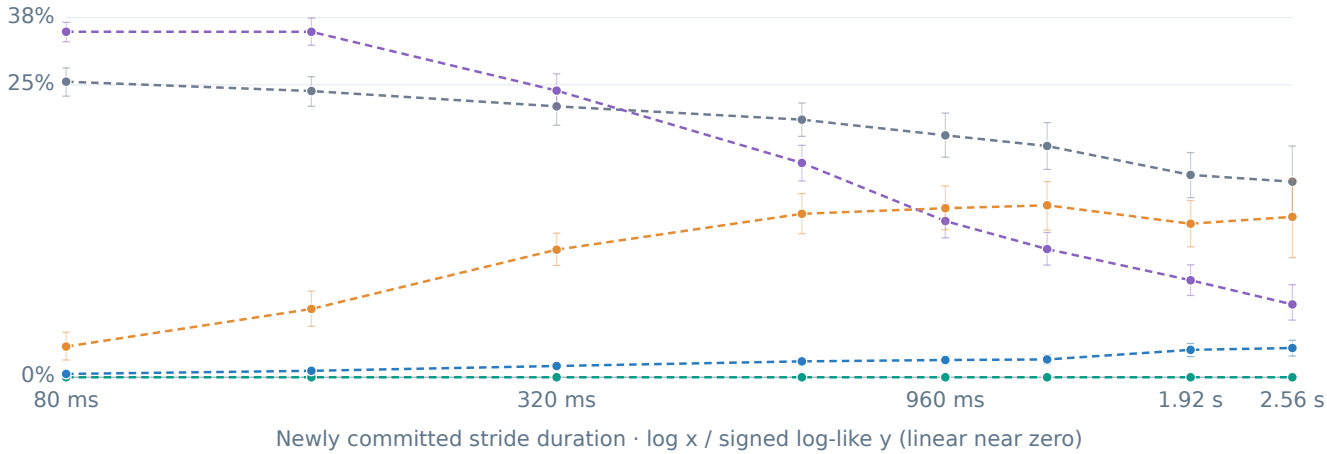
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Hann width 2S versus hard width S · equal emitted stride · positive = lower error with overlap

Qwen3-TTS Tokenizer 12Hz · Log-mel · paired equal-stride error reduction



● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Hann width 2S versus hard width S · equal emitted stride · positive = lower error with overlap

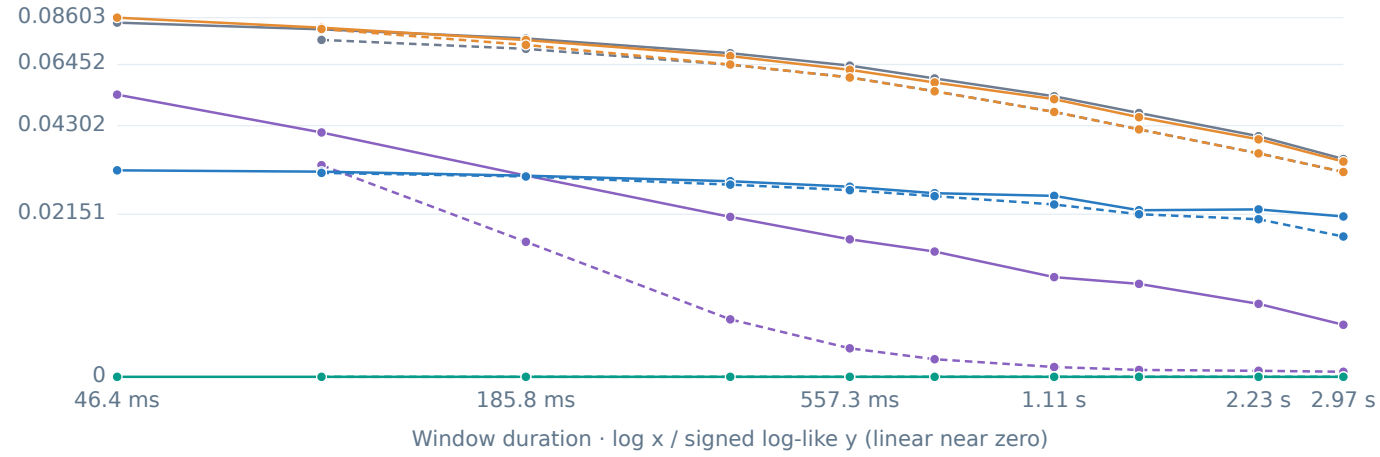
Qwen3-TTS Tokenizer 12Hz · Log1p-mel · paired equal-stride error reduction



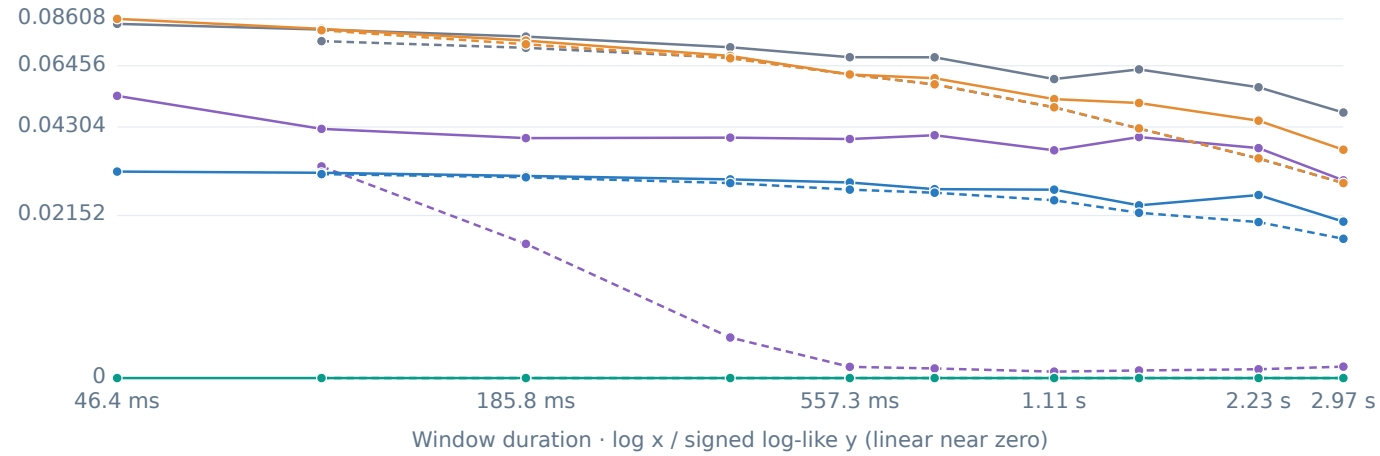
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Hann width 2S versus hard width S · equal emitted stride · positive = lower error with overlap

Where the boundary damage goes

Full-decode-to-treatment waveform drift isolates chunking from source quantization. Seam RMS is evaluated in a union of fixed-duration boundary neighborhoods; densely spaced seams can cover the whole clip. An unsupported interior is undefined, not zero. The seam-jump delta subtracts the full decoder’s natural transition.

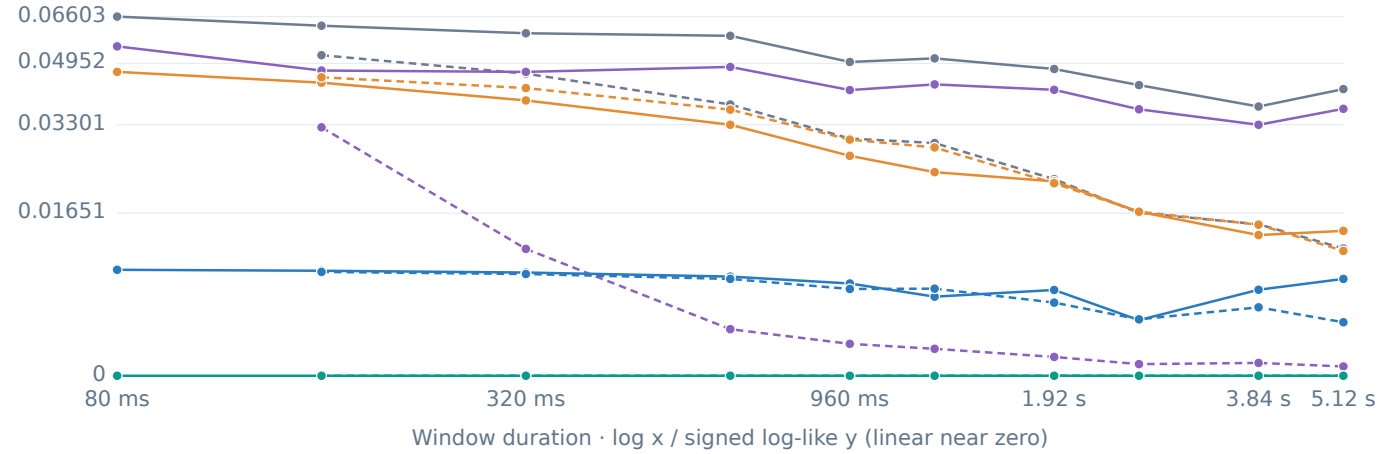


Fish S2-Pro codec · seam-neighborhood waveform drift RMS



● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Qwen3-TTS Tokenizer 12Hz · seam-neighborhood waveform drift RMS

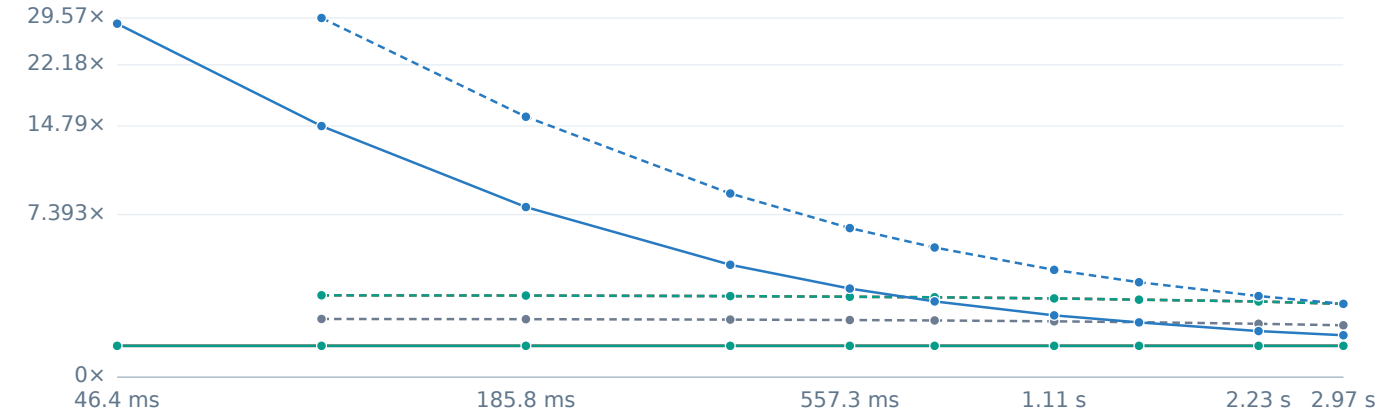


● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Quality is only half the tradeoff

Measured costs include this experimental Python state bookkeeping, convolution history and overlap rollback. They are prototype measurements, not optimized vendor-serving throughput. Codec tokens are already available; TTS generation, network and device playback latency are outside scope.

Each condition is a sequential single-stream pass on the shared NVIDIA L40S host. Unrelated benchmark and API services remained resident and were deliberately not stopped. This is not a dedicated, isolated, or warmed production-throughput trial.



Memory accounting: retained decoder-state bytes exclude raw input-code buffers. Replay 32 still needs up to 32 earlier frames of IDs: 2,560 bytes for Fish or 4,096 bytes for Qwen at int64, even when its retained decoder-state counter is zero. “Stateless” describes each decoder invocation, not zero streaming storage. Model weights, transient activations and allocator-reserved memory are also excluded. Each recorded condition is one CUDA-synchronized sequential pass, not a warmed repeated production-throughput benchmark.

Retained tensor bytes differ from transient peak allocations and allocator-reserved memory. Decode-frame work is a counter, not FLOPs. When state is rolled back by an extra prefix pass, that pass is included; do not assume all Hann50 policies cost exactly 2×.

Equal width is not equal latency

The equal-width view preserves the earlier overlap experiment. Hann50 emits a shorter stride and processes overlapping windows. The equal-stride view aligns newly committed token duration, but window holdback and tail finalization can still differ. The causal neural network has no future lookahead requirement; the OLA scheduling policy can nevertheless delay final waveform emission.

A correct timeline, not duplicated context

Overlapping windows start at 0, S, 2S, … while each contains W frames. The decoder must begin with state immediately before the window start, decode its provisional waveform, and commit only its S-frame prefix. The speculative suffix state is discarded or rolled back. Appending all W frames to a live cache and then appending the next overlap duplicates tokens and corrupts rotary positions.

Example: four-frame windows, two-frame stride

Decoded window	Start with history before	Commit new frames → next state	Roll back suffix state
[0, 4)	Frame 0 · empty	[0, 2) → before frame 2	[2, 4)
[2, 6)	Frame 2	[2, 4) → before frame 4	[4, 6)
[4, 8)	Frame 4	[4, 6) → before frame 6	[6, 8)

Intervals include the left endpoint and exclude the right. The provisional suffix waveform still contributes to overlap-add; its state is rolled back so the next window consumes each token once in the committed history.

Snapshots include K/V, global counters, convolution inputs, and transposed-convolution tails. A bias-free tail avoids adding convolution bias twice. The two experimental adapters may use different safe rollback implementations; work/time is reported for their actual behavior rather than an idealized production implementation.

For a bidirectional model, older deeper-layer keys/values can become stale when new right context arrives. The selected decoders are causal, so that caveat does not justify arbitrary future lookahead or an unlimited attention mask here.

> Deployment limitation: the isolated proof-of-concept adapters temporarily override module forward methods and support one independently managed stream. Concurrent calls sharing one decoder are unsupported; this is not a thread-safe production KV serving implementation. The experiment loaded its own models and did not modify the running benchmark API on port 40003.

Measurement protocol and limitations

Acoustic measurements

Source and reconstructed waveforms are evaluated as aligned 24 kHz mono without independent gain normalization. The whole-clip reference codes are reused; native decoded padding is cropped to source length before common-rate scoring.

Paired inference, not independent seams

Ratios use arithmetic means on matched eligible clips. Confidence intervals use 10,000 pooled paired clip bootstrap samples, not seams as independent

Log-mel L1 uses $\ln(M+10^{-5})$; log1p-mel uses $\ln(1+M)$ with the same magnitude mel transform. MR-STFT averages spectral convergence plus log-magnitude L1 at FFT sizes 512, 1024, and 2048 with hop FFT/4. Absolute source error and full-decoder drift are distinct endpoints.

subjects. The base seed is 20260928 with deterministic condition offsets. The initial cohort is balanced (20 sources per dataset), but the bootstrap is not stratified. The three illustrative listening sources are not the 60-clip population. The tested grid does not establish unseen integer thresholds.

Whole-state equivalence requires exact sample geometry, correct rectangular causal masks/positions, bounded layerwise cache histories, clip reset isolation, future-prefix independence, owned rollback snapshots and convolution tail handling. A smaller spectral error alone does not establish correctness.

The datasets here contain speech: cartoon dialogue, LibriSpeech Other and podcast audio. Findings do not establish music performance, other languages, quantized cache behavior, lossy sample-export equivalence, CPU production speed, or subjective human preference. Model weights and preinstalled Torch remain unchanged.

Recorded numerical-control protocol amendment

Independent-reset controls from the earlier experiment used grouped batching; this state experiment uses a single sequential stream. After a stock-operator batch-size calibration, the prior-reset agreement limit was explicitly amended and recorded below. This is not an all-state equivalence failure or a relaxation of the full-state correctness criterion. Measurements and checkpoint hashes remain attributable to their respective protocol versions.

Read the independent numerical calibration and control limits.


```
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calibration; all-state waveform criteria, treatments, widths, source population, weights, precision
and metric definitions unchanged."
}
```


Audio export and scoring-backend audit

The audit reread 579 lossless WAV assets, rescored all 570 treatments and 6 full controls, and compared the original CUDA scorer with independent explicit formulas. The absolute score-agreement bound remains 2e-05. CPU- and CUDA-created float32 Hann coefficients differed by up to 5.96e-08; the independent CPU scorer was therefore also evaluated with the exact original CUDA coefficients.

Scoring backend	Max MR-STFT difference	Max log-mel difference	Max log1p-mel difference	Fixed score bound
Original CUDA scorer	0	0	0	Within bound
Independent explicit CUDA scorer	1.192e-07	0	0	Within bound
CPU scorer + CPU Hann	2.17e-05	6.706e-07	3.725e-09	Outside bound
CPU scorer + exact CUDA Hann	2.432e-05	6.706e-07	3.725e-09	Outside bound

Using the exact CUDA Hann coefficients did not eliminate the independent CPU disagreement. The shared-window check therefore does not establish window coefficients as a sufficient explanation; FFT/reduction backend differences remain visible in the audit. Rescoring the exported WAVs with the original CUDA implementation produced a maximum score difference of 0.

The final metric-agreement audit uses independently implemented, explicit CUDA formulas at the unchanged 2e-05 bound, together with exact WAV integrity checks and independent statistical/provenance checks. CPU rescoring is retained as a separate portability diagnostic; it is not reported as a passing cross-backend check. This verification-backend choice changes neither the measured scores nor the waveform correctness criteria.

Each maximum covers baseline, treatment and full-decoder drift scores across every exported clip/method/window. This is a scoring-backend numerical diagnostic, not a change to exported audio, model output, measured results or the complete-state waveform criterion. The exact coefficient archive and its provenance document the original scoring constants without promising bit-identical FFT results across devices.

All backend comparisons and failures · Exact float32 Hann coefficients · Coefficient provenance and hashes.

Archived original native-CPU audit · Archived three-backend diagnostic. The final diagnostic records the verification amendment and archive hashes so the failed portability checks remain inspectable.

Research behind the experiment

The architecture and protocol were audited against primary sources and the installed pinned implementations. Published synthesis latency is not substituted for measured codec latency.

1. Fish Audio S2 technical report: causal convolution and transformer bottlenecks, separated from Slow/Fast AR token generation.
2. Qwen3-TTS technical report: installed 12.5 Hz causal tokenizer, distinct from the 25 Hz diffusion/lookahead tokenizer.
3. Pinned Fish codec implementation and official Qwen implementation: real attention and convolution execution paths.
4. Transformers caching documentation and PyTorch SDPA: past/current masks, offsets and rectangular causal attention.
5. Moshi / Mimi, streaming attention, and streaming convolutions: distinct bounded KV and waveform history states.
6. Parallel WaveGAN and Descript DAC: spectral reconstruction diagnostics are established but not human opinion scores.
7. ViSQOL, UTMOS, and ITU MUSHRA: complementary perceptual assessment; this page reports no new subjective MOS.
8. CUDA timing and memory semantics: asynchronous execution and allocated versus reserved memory.

Download and reproduce

Full report JSON · Every clip/condition CSV · Acoustic aggregates CSV · Equal-width paired contrasts CSV · Equal-stride paired contrasts JSON · Experiment validation · Sample export validation · Listening manifest and audio

hashes

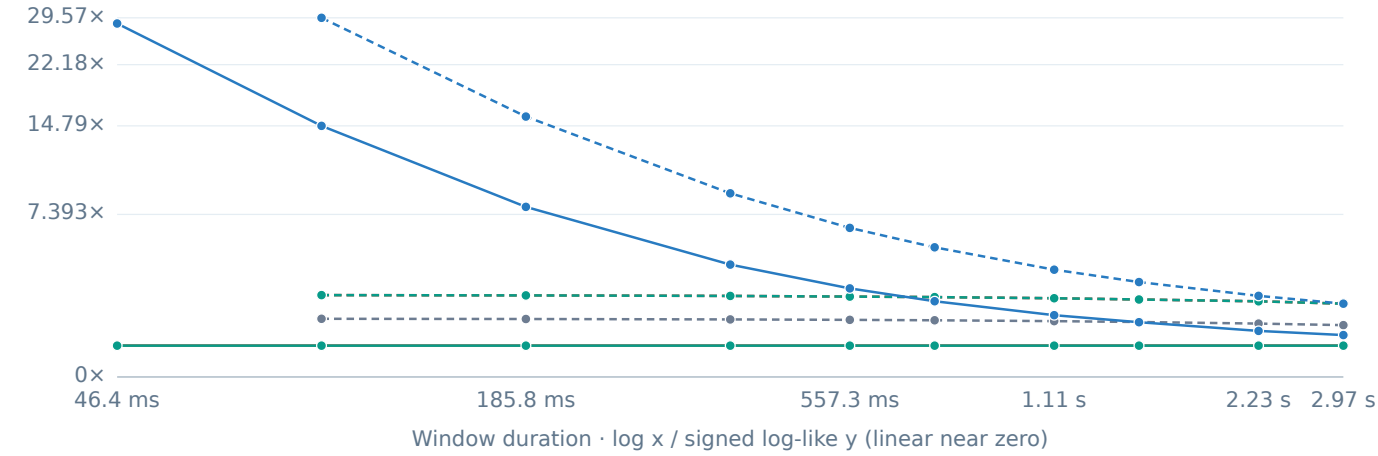
Primary-source and installed-code audits: Evaluation and protocol research · Fish state audit · Qwen state audit.

Experimental implementation: Benchmark runner · Fish state adapter · Qwen state adapter. The helpers share the original weights and do not modify upstream packages or the running benchmark API.

These downloads provide measurements, provenance pins and implementation excerpts for audit and reproduction. They are not a standalone runnable package: a complete rerun requires the local benchmark backend/environment, the pinned checkpoints, and access to all source corpora. The public site does not distribute the entire local environment or all 60 source files.

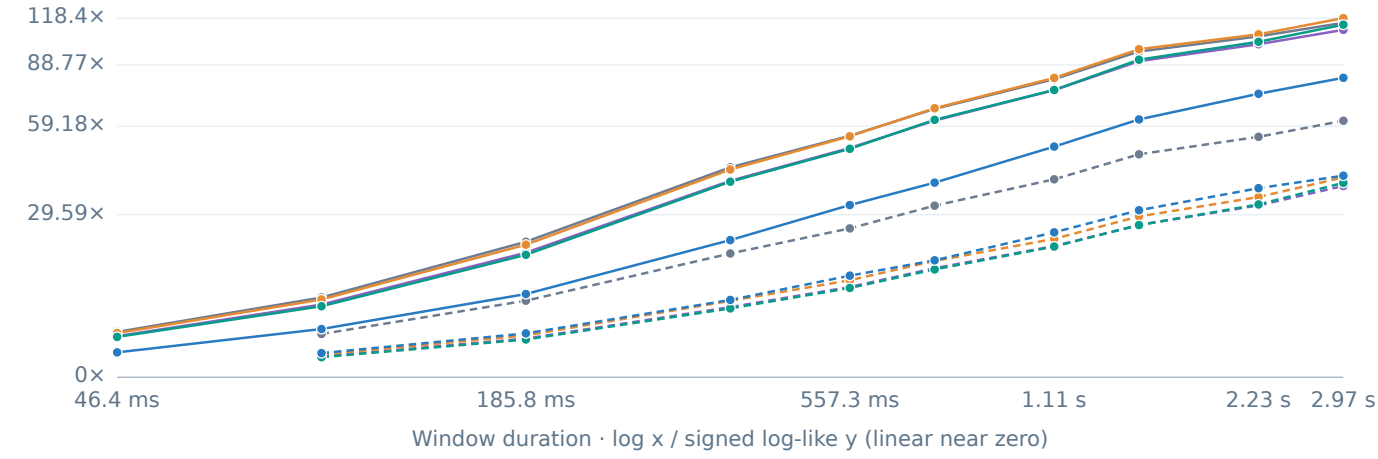
Compute and retained memory: both codecs

Fish S2-Pro codec · Actually processed token-frame work



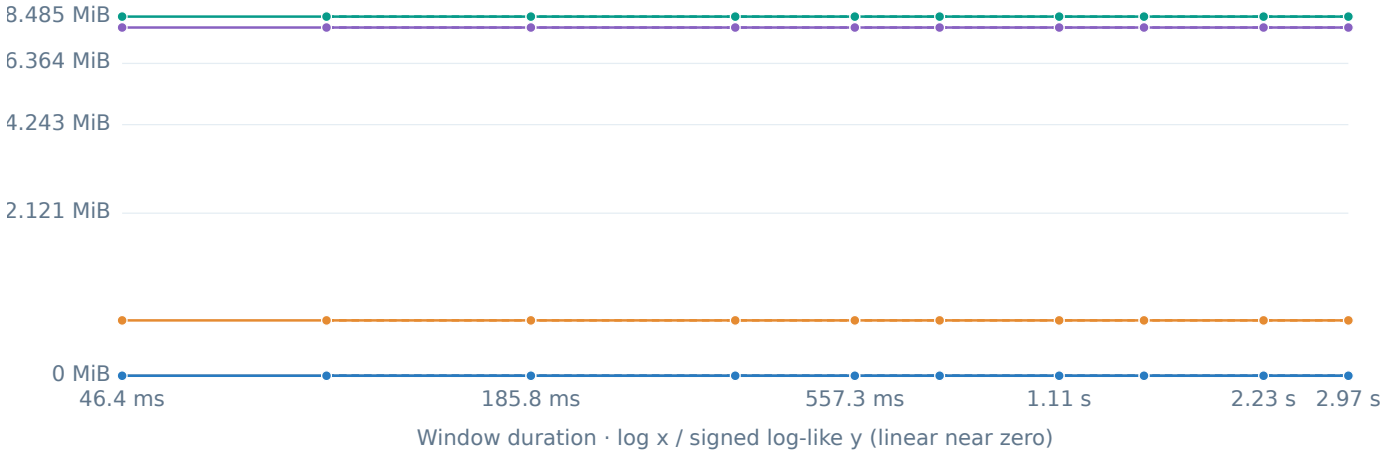
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Fish S2-Pro codec · Prototype decode throughput (× realtime)



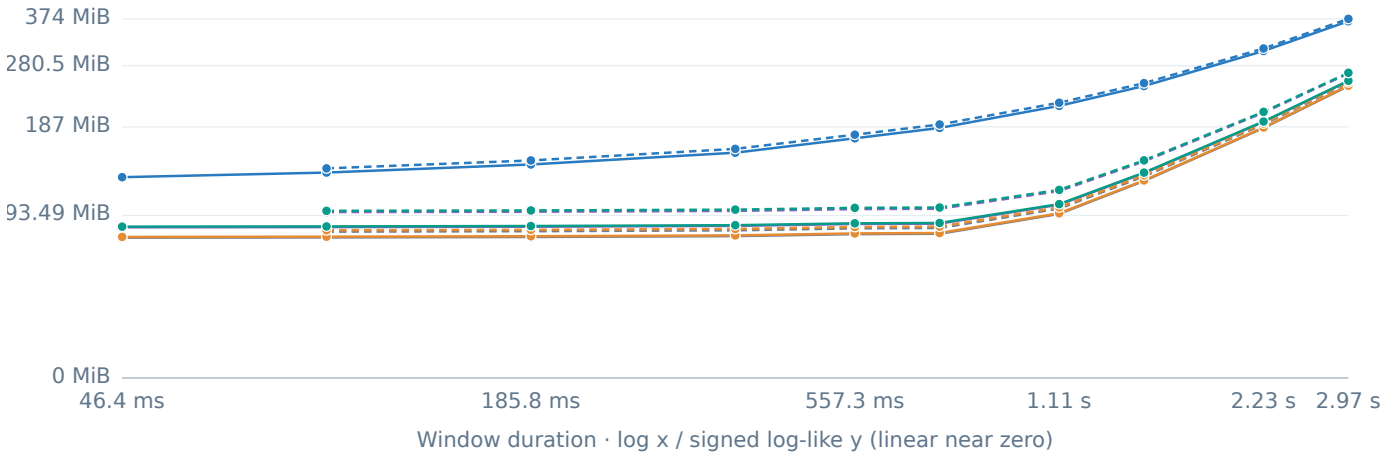
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Fish S2-Pro codec · Retained state tensor storage (MiB)



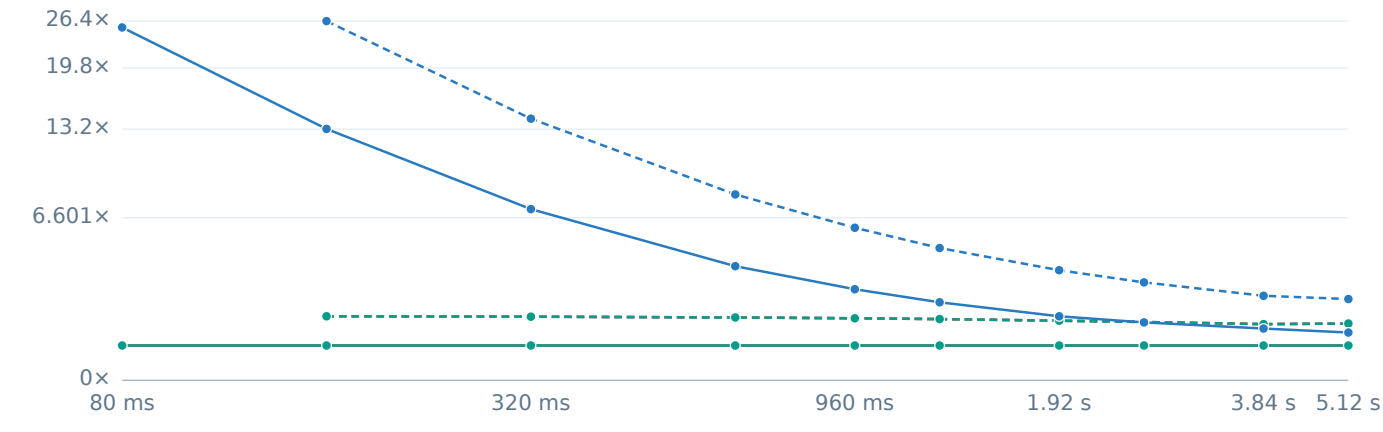
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Fish S2-Pro codec · Additional peak allocated GPU memory (MiB)



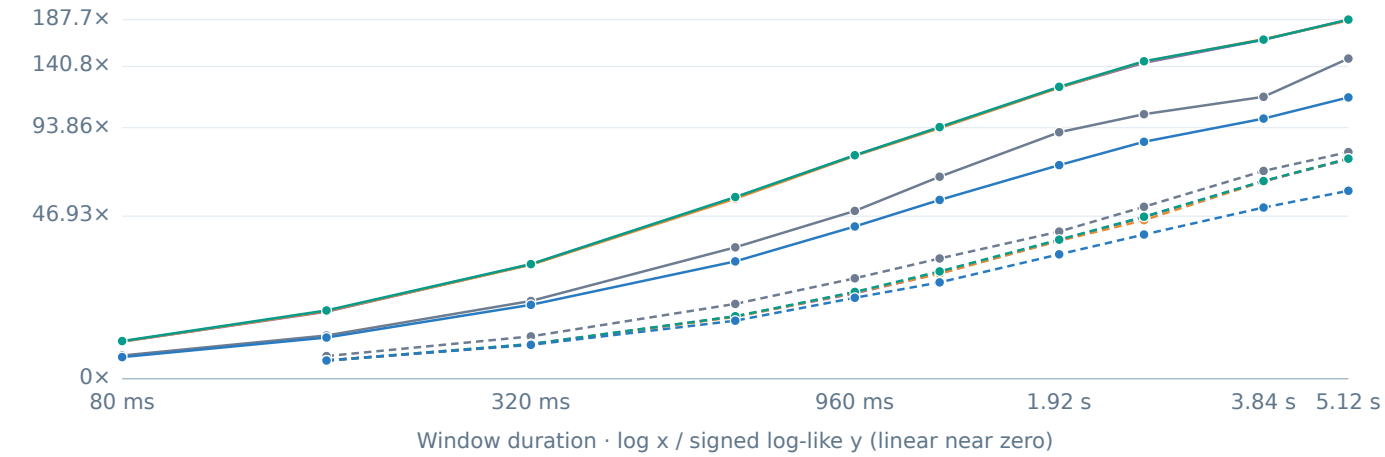
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Qwen3-TTS Tokenizer 12Hz · Actually processed token-frame work



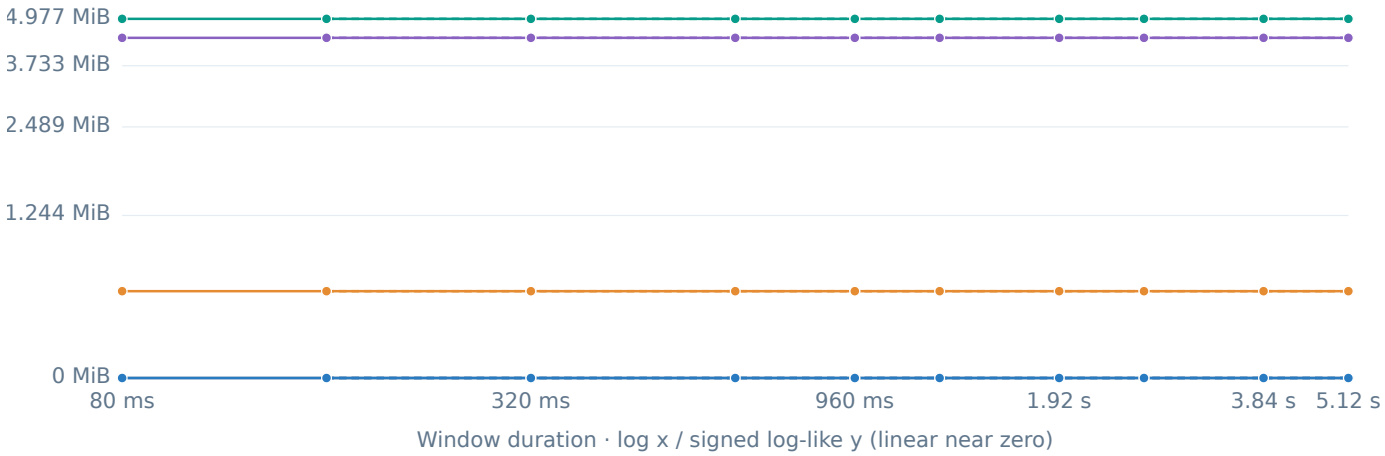
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Qwen3-TTS Tokenizer 12Hz · Prototype decode throughput (× realtime)



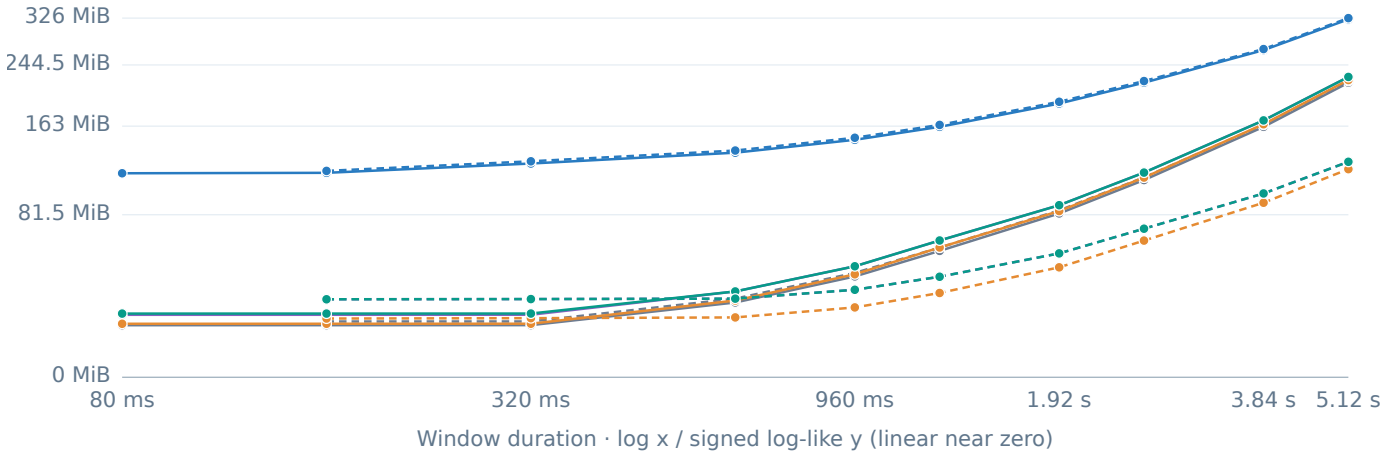
● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Qwen3-TTS Tokenizer 12Hz · Retained state tensor storage (MiB)



● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Qwen3-TTS Tokenizer 12Hz · Additional peak allocated GPU memory (MiB)



● Reset · ● KV only · ● Conv only · ● All state · ● Replay 32
Solid = hard joins · dashed = Hann50 · log duration axis

Complete overall acoustic aggregates

All completed measured method/window/metric combinations. Dataset-specific values are available through the cohort controls above.

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Fish S2-Pro	All state · hard joins	1	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	1	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	1	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · hard joins	1	mr_stft	60	2.004	+104.61%	+95.07% to +114.35%
Fish S2-Pro	Conv only · hard joins	1	log_mel	60	0.6939	+107.79%	+99.80% to +116.04%
Fish S2-Pro	Conv only · hard joins	1	log1p_mel	60	0.01521	+243.90%	+214.79% to +279.73%
Fish S2-Pro	KV only · hard joins	1	mr_stft	60	1.689	+72.39%	+67.86% to +77.11%
Fish S2-Pro	KV only · hard joins	1	log_mel	60	0.7349	+120.06%	+113.56% to +127.82%
Fish S2-Pro	KV only · hard joins	1	log1p_mel	60	0.01147	+159.38%	+148.70% to +170.25%
Fish S2-Pro	Reset · hard joins	1	mr_stft	60	2.263	+130.95%	+122.74% to +139.03%
Fish S2-Pro	Reset · hard joins	1	log_mel	60	0.9948	+197.88%	+190.76% to +205.25%
Fish S2-Pro	Reset · hard joins	1	log1p_mel	60	0.01818	+311.18%	+284.42% to +343.67%
Fish S2-Pro	Replay 32 · hard joins	1	mr_stft	60	1.164	+18.84%	+15.55% to +22.47%
Fish S2-Pro	Replay 32 · hard joins	1	log_mel	60	0.397	+18.87%	+16.03% to +21.96%
Fish S2-Pro	Replay 32 · hard joins	1	log1p_mel	60	0.005899	+33.39%	+28.20% to +39.47%
Fish S2-Pro	All state · Hann 50%	2	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	2	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	2	log1p_mel	60	0.004422	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	2	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	2	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	2	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	2	mr_stft	60	1.91	+94.95%	+86.00% to +104.21%
Fish S2-Pro	Conv only · Hann 50%	2	log_mel	60	0.6676	+99.90%	+92.28% to +108.18%
Fish S2-Pro	Conv only · Hann 50%	2	log1p_mel	60	0.01403	+217.22%	+190.86% to +250.25%
Fish S2-Pro	Conv only · hard joins	2	mr_stft	60	1.924	+96.38%	+87.21% to +105.75%
Fish S2-Pro	Conv only · hard joins	2	log_mel	60	0.6614	+98.05%	+90.34% to +106.46%
Fish S2-Pro	Conv only · hard joins	2	log1p_mel	60	0.01421	+221.41%	+193.75% to +255.15%
Fish S2-Pro	KV only · Hann 50%	2	mr_stft	60	1.236	+26.18%	+24.66% to +27.72%
Fish S2-Pro	KV only · Hann 50%	2	log_mel	60	0.517	+54.79%	+52.16% to +57.58%
Fish S2-Pro	KV only · Hann 50%	2	log1p_mel	60	0.007784	+76.00%	+70.52% to +81.15%
Fish S2-Pro	KV only · hard joins	2	mr_stft	60	1.425	+45.51%	+42.27% to +48.84%
Fish S2-Pro	KV only · hard joins	2	log_mel	60	0.5827	+74.49%	+70.04% to +79.88%
Fish S2-Pro	KV only · hard joins	2	log1p_mel	60	0.008716	+97.10%	+90.65% to +103.48%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Fish S2-Pro	Reset · Hann 50%	2	mr_stft	60	1.906	+94.58%	+87.66% to +101.65%
Fish S2-Pro	Reset · Hann 50%	2	log_mel	60	0.7831	+134.48%	+127.65% to +141.38%
Fish S2-Pro	Reset · Hann 50%	2	log1p_mel	60	0.01426	+222.36%	+202.19% to +246.84%
Fish S2-Pro	Reset · hard joins	2	mr_stft	60	2.088	+113.13%	+105.03% to +121.15%
Fish S2-Pro	Reset · hard joins	2	log_mel	60	0.8585	+157.06%	+150.38% to +164.14%
Fish S2-Pro	Reset · hard joins	2	log1p_mel	60	0.01598	+261.42%	+237.13% to +291.42%
Fish S2-Pro	Replay 32 · Hann 50%	2	mr_stft	60	1.141	+16.50%	+13.59% to +19.61%
Fish S2-Pro	Replay 32 · Hann 50%	2	log_mel	60	0.3878	+16.12%	+13.47% to +18.81%
Fish S2-Pro	Replay 32 · Hann 50%	2	log1p_mel	60	0.00582	+31.59%	+26.84% to +37.16%
Fish S2-Pro	Replay 32 · hard joins	2	mr_stft	60	1.155	+17.92%	+14.76% to +21.41%
Fish S2-Pro	Replay 32 · hard joins	2	log_mel	60	0.3943	+18.08%	+15.34% to +21.06%
Fish S2-Pro	Replay 32 · hard joins	2	log1p_mel	60	0.005861	+32.53%	+27.44% to +38.54%
Fish S2-Pro	All state · Hann 50%	4	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	4	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	4	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	4	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	4	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	4	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	4	mr_stft	60	1.795	+83.21%	+74.58% to +92.07%
Fish S2-Pro	Conv only · Hann 50%	4	log_mel	60	0.6254	+87.27%	+79.66% to +95.44%
Fish S2-Pro	Conv only · Hann 50%	4	log1p_mel	60	0.01267	+186.53%	+163.05% to +215.37%
Fish S2-Pro	Conv only · hard joins	4	mr_stft	60	1.823	+86.12%	+77.65% to +95.16%
Fish S2-Pro	Conv only · hard joins	4	log_mel	60	0.6247	+87.06%	+79.78% to +95.11%
Fish S2-Pro	Conv only · hard joins	4	log1p_mel	60	0.01304	+194.79%	+170.32% to +225.81%
Fish S2-Pro	KV only · Hann 50%	4	mr_stft	60	1.04	+6.19%	+5.44% to +6.91%
Fish S2-Pro	KV only · Hann 50%	4	log_mel	60	0.3922	+17.43%	+16.10% to +18.83%
Fish S2-Pro	KV only · Hann 50%	4	log1p_mel	60	0.005373	+21.48%	+19.12% to +23.80%
Fish S2-Pro	KV only · hard joins	4	mr_stft	60	1.228	+25.34%	+23.37% to +27.36%
Fish S2-Pro	KV only · hard joins	4	log_mel	60	0.4637	+38.83%	+36.17% to +42.00%
Fish S2-Pro	KV only · hard joins	4	log1p_mel	60	0.006702	+51.55%	+48.19% to +54.76%
Fish S2-Pro	Reset · Hann 50%	4	mr_stft	60	1.78	+81.74%	+74.04% to +89.82%
Fish S2-Pro	Reset · Hann 50%	4	log_mel	60	0.6571	+96.77%	+89.89% to +104.13%
Fish S2-Pro	Reset · Hann 50%	4	log1p_mel	60	0.01255	+183.67%	+163.10% to +209.21%
Fish S2-Pro	Reset · hard joins	4	mr_stft	60	1.94	+97.99%	+89.77% to +106.24%
Fish S2-Pro	Reset · hard joins	4	log_mel	60	0.7387	+121.19%	+114.15% to +128.84%
Fish S2-Pro	Reset · hard joins	4	log1p_mel	60	0.0142	+221.20%	+197.74% to +250.59%
Fish S2-Pro	Replay 32 · Hann 50%	4	mr_stft	60	1.134	+15.76%	+12.91% to +18.83%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Fish S2-Pro	Replay 32 · Hann 50%	4	log_mel	60	0.3862	+15.65%	+13.03% to +18.43%
Fish S2-Pro	Replay 32 · Hann 50%	4	log1p_mel	60	0.005765	+30.35%	+25.70% to +35.63%
Fish S2-Pro	Replay 32 · hard joins	4	mr_stft	60	1.143	+16.68%	+13.81% to +19.82%
Fish S2-Pro	Replay 32 · hard joins	4	log_mel	60	0.3899	+16.73%	+14.15% to +19.44%
Fish S2-Pro	Replay 32 · hard joins	4	log1p_mel	60	0.005779	+30.68%	+26.06% to +36.17%
Fish S2-Pro	All state · Hann 50%	8	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	8	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	8	log1p_mel	60	0.004422	-0.00%	-0.00% to -0.00%
Fish S2-Pro	All state · hard joins	8	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	8	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	8	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	8	mr_stft	60	1.648	+68.19%	+60.92% to +75.83%
Fish S2-Pro	Conv only · Hann 50%	8	log_mel	60	0.5757	+72.38%	+65.64% to +80.04%
Fish S2-Pro	Conv only · Hann 50%	8	log1p_mel	60	0.0111	+151.06%	+131.97% to +175.45%
Fish S2-Pro	Conv only · hard joins	8	mr_stft	60	1.696	+73.11%	+65.15% to +81.57%
Fish S2-Pro	Conv only · hard joins	8	log_mel	60	0.5808	+73.91%	+67.02% to +81.52%
Fish S2-Pro	Conv only · hard joins	8	log1p_mel	60	0.01167	+163.94%	+143.20% to +189.52%
Fish S2-Pro	KV only · Hann 50%	8	mr_stft	60	0.9886	+0.91%	+0.59% to +1.22%
Fish S2-Pro	KV only · Hann 50%	8	log_mel	60	0.3471	+3.93%	+3.41% to +4.46%
Fish S2-Pro	KV only · Hann 50%	8	log1p_mel	60	0.004588	+3.73%	+3.13% to +4.37%
Fish S2-Pro	KV only · hard joins	8	mr_stft	60	1.107	+12.95%	+11.84% to +14.10%
Fish S2-Pro	KV only · hard joins	8	log_mel	60	0.3951	+18.32%	+16.98% to +19.79%
Fish S2-Pro	KV only · hard joins	8	log1p_mel	60	0.005563	+25.78%	+24.15% to +27.46%
Fish S2-Pro	Reset · Hann 50%	8	mr_stft	60	1.649	+68.36%	+61.03% to +75.97%
Fish S2-Pro	Reset · Hann 50%	8	log_mel	60	0.5826	+74.46%	+67.74% to +81.85%
Fish S2-Pro	Reset · Hann 50%	8	log1p_mel	60	0.01111	+151.13%	+132.35% to +174.56%
Fish S2-Pro	Reset · hard joins	8	mr_stft	60	1.773	+80.96%	+72.94% to +89.21%
Fish S2-Pro	Reset · hard joins	8	log_mel	60	0.6418	+92.16%	+85.13% to +99.74%
Fish S2-Pro	Reset · hard joins	8	log1p_mel	60	0.01243	+180.98%	+160.28% to +206.07%
Fish S2-Pro	Replay 32 · Hann 50%	8	mr_stft	60	1.121	+14.46%	+11.82% to +17.27%
Fish S2-Pro	Replay 32 · Hann 50%	8	log_mel	60	0.3823	+14.48%	+12.09% to +16.96%
Fish S2-Pro	Replay 32 · Hann 50%	8	log1p_mel	60	0.005658	+27.95%	+23.70% to +32.93%
Fish S2-Pro	Replay 32 · hard joins	8	mr_stft	60	1.13	+15.37%	+12.41% to +18.57%
Fish S2-Pro	Replay 32 · hard joins	8	log_mel	60	0.3847	+15.19%	+12.58% to +17.92%
Fish S2-Pro	Replay 32 · hard joins	8	log1p_mel	60	0.005687	+28.58%	+23.82% to +34.13%
Fish S2-Pro	All state · Hann 50%	12	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	12	log_mel	60	0.334	+0.00%	-0.00% to +0.00%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Fish S2-Pro	All state · Hann 50%	12	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	12	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	12	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	12	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	12	mr_stft	60	1.551	+58.33%	+51.58% to +65.49%
Fish S2-Pro	Conv only · Hann 50%	12	log_mel	60	0.5425	+62.43%	+56.06% to +69.57%
Fish S2-Pro	Conv only · Hann 50%	12	log1p_mel	60	0.01012	+128.77%	+111.52% to +149.50%
Fish S2-Pro	Conv only · hard joins	12	mr_stft	60	1.599	+63.26%	+56.30% to +70.51%
Fish S2-Pro	Conv only · hard joins	12	log_mel	60	0.5462	+63.57%	+57.20% to +70.63%
Fish S2-Pro	Conv only · hard joins	12	log1p_mel	60	0.01055	+138.52%	+119.90% to +160.75%
Fish S2-Pro	KV only · Hann 50%	12	mr_stft	60	0.9823	+0.27%	+0.14% to +0.40%
Fish S2-Pro	KV only · Hann 50%	12	log_mel	60	0.3392	+1.56%	+1.29% to +1.86%
Fish S2-Pro	KV only · Hann 50%	12	log1p_mel	60	0.004472	+1.12%	+0.91% to +1.34%
Fish S2-Pro	KV only · hard joins	12	mr_stft	60	1.071	+9.33%	+8.30% to +10.41%
Fish S2-Pro	KV only · hard joins	12	log_mel	60	0.3756	+12.48%	+11.48% to +13.61%
Fish S2-Pro	KV only · hard joins	12	log1p_mel	60	0.005177	+17.06%	+15.66% to +18.59%
Fish S2-Pro	Reset · Hann 50%	12	mr_stft	60	1.554	+58.61%	+51.89% to +65.72%
Fish S2-Pro	Reset · Hann 50%	12	log_mel	60	0.5458	+63.44%	+56.85% to +70.96%
Fish S2-Pro	Reset · Hann 50%	12	log1p_mel	60	0.01013	+129.14%	+112.17% to +149.83%
Fish S2-Pro	Reset · hard joins	12	mr_stft	60	1.665	+70.00%	+62.61% to +77.51%
Fish S2-Pro	Reset · hard joins	12	log_mel	60	0.5906	+76.84%	+70.27% to +83.84%
Fish S2-Pro	Reset · hard joins	12	log1p_mel	60	0.01114	+151.83%	+132.96% to +174.66%
Fish S2-Pro	Replay 32 · Hann 50%	12	mr_stft	60	1.114	+13.71%	+11.08% to +16.61%
Fish S2-Pro	Replay 32 · Hann 50%	12	log_mel	60	0.3796	+13.67%	+11.27% to +16.15%
Fish S2-Pro	Replay 32 · Hann 50%	12	log1p_mel	60	0.005584	+26.26%	+22.04% to +31.02%
Fish S2-Pro	Replay 32 · hard joins	12	mr_stft	60	1.117	+14.02%	+11.37% to +16.79%
Fish S2-Pro	Replay 32 · hard joins	12	log_mel	60	0.3794	+13.61%	+11.27% to +16.12%
Fish S2-Pro	Replay 32 · hard joins	12	log1p_mel	60	0.005582	+26.21%	+22.08% to +30.75%
Fish S2-Pro	All state · Hann 50%	16	mr_stft	60	0.9796	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	16	log_mel	60	0.334	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	16	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	16	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	16	log_mel	60	0.334	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	16	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	16	mr_stft	60	1.48	+51.10%	+44.86% to +57.59%
Fish S2-Pro	Conv only · Hann 50%	16	log_mel	60	0.5162	+54.58%	+48.70% to +61.05%
Fish S2-Pro	Conv only · Hann 50%	16	log1p_mel	60	0.009328	+110.92%	+95.60% to +129.80%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Fish S2-Pro	Conv only · hard joins	16	mr_stft	60	1.531	+56.33%	+49.94% to +63.20%
Fish S2-Pro	Conv only · hard joins	16	log_mel	60	0.5202	+55.76%	+49.90% to +61.94%
Fish S2-Pro	Conv only · hard joins	16	log1p_mel	60	0.009679	+118.87%	+103.78% to +137.79%
Fish S2-Pro	KV only · Hann 50%	16	mr_stft	60	0.9811	+0.15%	+0.08% to +0.22%
Fish S2-Pro	KV only · Hann 50%	16	log_mel	60	0.3367	+0.83%	+0.67% to +0.99%
Fish S2-Pro	KV only · Hann 50%	16	log1p_mel	60	0.004446	+0.53%	+0.38% to +0.70%
Fish S2-Pro	KV only · hard joins	16	mr_stft	60	1.044	+6.54%	+5.93% to +7.18%
Fish S2-Pro	KV only · hard joins	16	log_mel	60	0.3636	+8.86%	+8.17% to +9.65%
Fish S2-Pro	KV only · hard joins	16	log1p_mel	60	0.004972	+12.43%	+11.30% to +13.57%
Fish S2-Pro	Reset · Hann 50%	16	mr_stft	60	1.482	+51.28%	+44.91% to +57.80%
Fish S2-Pro	Reset · Hann 50%	16	log_mel	60	0.5181	+55.13%	+49.20% to +61.67%
Fish S2-Pro	Reset · Hann 50%	16	log1p_mel	60	0.009337	+111.13%	+96.00% to +129.63%
Fish S2-Pro	Reset · hard joins	16	mr_stft	60	1.583	+61.58%	+54.91% to +68.69%
Fish S2-Pro	Reset · hard joins	16	log_mel	60	0.5526	+65.47%	+59.91% to +71.64%
Fish S2-Pro	Reset · hard joins	16	log1p_mel	60	0.01015	+129.56%	+114.55% to +148.84%
Fish S2-Pro	Replay 32 · Hann 50%	16	mr_stft	60	1.103	+12.63%	+10.13% to +15.31%
Fish S2-Pro	Replay 32 · Hann 50%	16	log_mel	60	0.3764	+12.70%	+10.39% to +15.14%
Fish S2-Pro	Replay 32 · Hann 50%	16	log1p_mel	60	0.005501	+24.38%	+20.11% to +29.03%
Fish S2-Pro	Replay 32 · hard joins	16	mr_stft	60	1.114	+13.74%	+10.92% to +16.66%
Fish S2-Pro	Replay 32 · hard joins	16	log_mel	60	0.3788	+13.43%	+10.98% to +15.95%
Fish S2-Pro	Replay 32 · hard joins	16	log1p_mel	60	0.005542	+25.32%	+20.82% to +30.18%
Fish S2-Pro	All state · Hann 50%	24	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	24	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	24	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	24	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	24	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	24	log1p_mel	60	0.004422	-0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	24	mr_stft	60	1.376	+40.44%	+35.24% to +46.01%
Fish S2-Pro	Conv only · Hann 50%	24	log_mel	60	0.4782	+43.20%	+38.26% to +48.55%
Fish S2-Pro	Conv only · Hann 50%	24	log1p_mel	60	0.008212	+85.70%	+73.36% to +100.29%
Fish S2-Pro	Conv only · hard joins	24	mr_stft	60	1.419	+44.88%	+38.82% to +51.39%
Fish S2-Pro	Conv only · hard joins	24	log_mel	60	0.4792	+43.48%	+38.38% to +48.92%
Fish S2-Pro	Conv only · hard joins	24	log1p_mel	60	0.008593	+94.31%	+81.11% to +109.48%
Fish S2-Pro	KV only · Hann 50%	24	mr_stft	60	0.9802	+0.05%	+0.01% to +0.09%
Fish S2-Pro	KV only · Hann 50%	24	log_mel	60	0.335	+0.32%	+0.25% to +0.39%
Fish S2-Pro	KV only · Hann 50%	24	log1p_mel	60	0.004428	+0.13%	+0.07% to +0.20%
Fish S2-Pro	KV only · hard joins	24	mr_stft	60	1.022	+4.34%	+3.78% to +4.94%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Fish S2-Pro	KV only · hard joins	24	log_mel	60	0.3537	+5.92%	+5.26% to +6.87%
Fish S2-Pro	KV only · hard joins	24	log1p_mel	60	0.004768	+7.81%	+7.01% to +8.59%
Fish S2-Pro	Reset · Hann 50%	24	mr_stft	60	1.377	+40.52%	+35.26% to +46.10%
Fish S2-Pro	Reset · Hann 50%	24	log_mel	60	0.4792	+43.48%	+38.51% to +48.83%
Fish S2-Pro	Reset · Hann 50%	24	log1p_mel	60	0.008216	+85.78%	+73.64% to +100.39%
Fish S2-Pro	Reset · hard joins	24	mr_stft	60	1.458	+48.79%	+42.45% to +55.34%
Fish S2-Pro	Reset · hard joins	24	log_mel	60	0.5017	+50.22%	+45.03% to +55.66%
Fish S2-Pro	Reset · hard joins	24	log1p_mel	60	0.008902	+101.29%	+87.72% to +117.34%
Fish S2-Pro	Replay 32 · Hann 50%	24	mr_stft	60	1.086	+10.86%	+8.58% to +13.31%
Fish S2-Pro	Replay 32 · Hann 50%	24	log_mel	60	0.371	+11.10%	+8.99% to +13.36%
Fish S2-Pro	Replay 32 · Hann 50%	24	log1p_mel	60	0.005367	+21.35%	+17.62% to +25.41%
Fish S2-Pro	Replay 32 · hard joins	24	mr_stft	60	1.096	+11.86%	+9.36% to +14.48%
Fish S2-Pro	Replay 32 · hard joins	24	log_mel	60	0.3721	+11.42%	+9.29% to +13.73%
Fish S2-Pro	Replay 32 · hard joins	24	log1p_mel	60	0.005399	+22.08%	+18.27% to +26.11%
Fish S2-Pro	All state · Hann 50%	32	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	32	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	32	log1p_mel	60	0.004422	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	32	mr_stft	60	0.9796	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	32	log_mel	60	0.334	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	32	log1p_mel	60	0.004422	+0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	32	mr_stft	60	1.31	+33.76%	+28.92% to +39.05%
Fish S2-Pro	Conv only · Hann 50%	32	log_mel	60	0.454	+35.93%	+31.33% to +40.77%
Fish S2-Pro	Conv only · Hann 50%	32	log1p_mel	60	0.007488	+69.32%	+59.17% to +81.52%
Fish S2-Pro	Conv only · hard joins	32	mr_stft	60	1.347	+37.52%	+32.40% to +43.20%
Fish S2-Pro	Conv only · hard joins	32	log_mel	60	0.4562	+36.59%	+32.16% to +41.42%
Fish S2-Pro	Conv only · hard joins	32	log1p_mel	60	0.007703	+74.19%	+63.53% to +87.08%
Fish S2-Pro	KV only · Hann 50%	32	mr_stft	60	0.9802	+0.05%	+0.02% to +0.09%
Fish S2-Pro	KV only · Hann 50%	32	log_mel	60	0.3347	+0.23%	+0.15% to +0.33%
Fish S2-Pro	KV only · Hann 50%	32	log1p_mel	60	0.004428	+0.13%	+0.07% to +0.20%
Fish S2-Pro	KV only · hard joins	32	mr_stft	60	1.01	+3.11%	+2.66% to +3.60%
Fish S2-Pro	KV only · hard joins	32	log_mel	60	0.3468	+3.84%	+3.47% to +4.20%
Fish S2-Pro	KV only · hard joins	32	log1p_mel	60	0.004688	+6.00%	+5.34% to +6.66%
Fish S2-Pro	Reset · Hann 50%	32	mr_stft	60	1.311	+33.81%	+29.05% to +39.03%
Fish S2-Pro	Reset · Hann 50%	32	log_mel	60	0.4548	+36.19%	+31.74% to +41.29%
Fish S2-Pro	Reset · Hann 50%	32	log1p_mel	60	0.007491	+69.39%	+59.31% to +81.38%
Fish S2-Pro	Reset · hard joins	32	mr_stft	60	1.376	+40.51%	+35.26% to +46.13%
Fish S2-Pro	Reset · hard joins	32	log_mel	60	0.4716	+41.22%	+36.84% to +46.16%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Fish S2-Pro	Reset · hard joins	32	log1p_mel	60	0.007951	+79.79%	+69.05% to +92.94%
Fish S2-Pro	Replay 32 · Hann 50%	32	mr_stft	60	1.075	+9.73%	+7.58% to +12.06%
Fish S2-Pro	Replay 32 · Hann 50%	32	log_mel	60	0.3677	+10.10%	+7.99% to +12.27%
Fish S2-Pro	Replay 32 · Hann 50%	32	log1p_mel	60	0.005246	+18.62%	+15.15% to +22.32%
Fish S2-Pro	Replay 32 · hard joins	32	mr_stft	60	1.079	+10.12%	+7.63% to +12.79%
Fish S2-Pro	Replay 32 · hard joins	32	log_mel	60	0.3679	+10.17%	+8.01% to +12.48%
Fish S2-Pro	Replay 32 · hard joins	32	log1p_mel	60	0.005257	+18.87%	+15.07% to +22.94%
Fish S2-Pro	All state · Hann 50%	48	mr_stft	59	0.9804	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	48	log_mel	59	0.3341	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	48	log1p_mel	59	0.004413	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	48	mr_stft	59	0.9804	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	48	log_mel	59	0.3341	+0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	48	log1p_mel	59	0.004413	+0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	48	mr_stft	59	1.217	+24.10%	+20.39% to +28.11%
Fish S2-Pro	Conv only · Hann 50%	48	log_mel	59	0.4196	+25.60%	+21.99% to +29.37%
Fish S2-Pro	Conv only · Hann 50%	48	log1p_mel	59	0.006567	+48.82%	+41.33% to +57.38%
Fish S2-Pro	Conv only · hard joins	48	mr_stft	59	1.273	+29.81%	+24.61% to +35.22%
Fish S2-Pro	Conv only · hard joins	48	log_mel	59	0.4246	+27.11%	+23.27% to +31.20%
Fish S2-Pro	Conv only · hard joins	48	log1p_mel	59	0.007022	+59.14%	+49.66% to +69.41%
Fish S2-Pro	KV only · Hann 50%	48	mr_stft	59	0.9808	+0.04%	+0.01% to +0.08%
Fish S2-Pro	KV only · Hann 50%	48	log_mel	59	0.3346	+0.15%	+0.09% to +0.22%
Fish S2-Pro	KV only · Hann 50%	48	log1p_mel	59	0.004417	+0.09%	+0.04% to +0.16%
Fish S2-Pro	KV only · hard joins	48	mr_stft	59	1.002	+2.17%	+1.79% to +2.58%
Fish S2-Pro	KV only · hard joins	48	log_mel	59	0.3431	+2.70%	+2.31% to +3.22%
Fish S2-Pro	KV only · hard joins	48	log1p_mel	59	0.004569	+3.54%	+3.06% to +4.08%
Fish S2-Pro	Reset · Hann 50%	48	mr_stft	59	1.217	+24.16%	+20.53% to +28.16%
Fish S2-Pro	Reset · Hann 50%	48	log_mel	59	0.4201	+25.76%	+22.16% to +29.57%
Fish S2-Pro	Reset · Hann 50%	48	log1p_mel	59	0.00657	+48.88%	+41.44% to +57.60%
Fish S2-Pro	Reset · hard joins	48	mr_stft	59	1.295	+32.12%	+27.04% to +37.65%
Fish S2-Pro	Reset · hard joins	48	log_mel	59	0.4355	+30.38%	+26.57% to +34.46%
Fish S2-Pro	Reset · hard joins	48	log1p_mel	59	0.007183	+62.77%	+53.40% to +73.39%
Fish S2-Pro	Replay 32 · Hann 50%	48	mr_stft	59	1.058	+7.90%	+6.04% to +9.92%
Fish S2-Pro	Replay 32 · Hann 50%	48	log_mel	59	0.3615	+8.21%	+6.42% to +10.14%
Fish S2-Pro	Replay 32 · Hann 50%	48	log1p_mel	59	0.005101	+15.60%	+12.39% to +18.77%
Fish S2-Pro	Replay 32 · hard joins	48	mr_stft	59	1.075	+9.68%	+7.43% to +12.13%
Fish S2-Pro	Replay 32 · hard joins	48	log_mel	59	0.3644	+9.09%	+7.21% to +11.10%
Fish S2-Pro	Replay 32 · hard joins	48	log1p_mel	59	0.005168	+17.11%	+13.87% to +20.37%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Fish S2-Pro	All state · Hann 50%	64	mr_stft	58	0.9772	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · Hann 50%	64	log_mel	58	0.3328	-0.00%	-0.00% to -0.00%
Fish S2-Pro	All state · Hann 50%	64	log1p_mel	58	0.004425	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	64	mr_stft	58	0.9772	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	64	log_mel	58	0.3328	-0.00%	-0.00% to +0.00%
Fish S2-Pro	All state · hard joins	64	log1p_mel	58	0.004425	-0.00%	-0.00% to +0.00%
Fish S2-Pro	Conv only · Hann 50%	64	mr_stft	58	1.169	+19.59%	+16.15% to +23.46%
Fish S2-Pro	Conv only · Hann 50%	64	log_mel	58	0.4034	+21.23%	+17.91% to +24.91%
Fish S2-Pro	Conv only · Hann 50%	64	log1p_mel	58	0.006109	+38.06%	+31.98% to +45.34%
Fish S2-Pro	Conv only · hard joins	64	mr_stft	58	1.188	+21.53%	+17.72% to +25.47%
Fish S2-Pro	Conv only · hard joins	64	log_mel	58	0.3996	+20.07%	+17.03% to +23.33%
Fish S2-Pro	Conv only · hard joins	64	log1p_mel	58	0.006226	+40.70%	+34.41% to +47.70%
Fish S2-Pro	KV only · Hann 50%	64	mr_stft	58	0.9776	+0.05%	+0.01% to +0.08%
Fish S2-Pro	KV only · Hann 50%	64	log_mel	58	0.3333	+0.15%	+0.08% to +0.24%
Fish S2-Pro	KV only · Hann 50%	64	log1p_mel	58	0.004429	+0.09%	+0.03% to +0.17%
Fish S2-Pro	KV only · hard joins	64	mr_stft	58	0.988	+1.11%	+0.85% to +1.39%
Fish S2-Pro	KV only · hard joins	64	log_mel	58	0.3382	+1.63%	+1.40% to +1.87%
Fish S2-Pro	KV only · hard joins	64	log1p_mel	58	0.004521	+2.17%	+1.80% to +2.57%
Fish S2-Pro	Reset · Hann 50%	64	mr_stft	58	1.169	+19.61%	+16.22% to +23.48%
Fish S2-Pro	Reset · Hann 50%	64	log_mel	58	0.4039	+21.37%	+18.05% to +25.08%
Fish S2-Pro	Reset · Hann 50%	64	log1p_mel	58	0.006111	+38.10%	+31.77% to +45.44%
Fish S2-Pro	Reset · hard joins	64	mr_stft	58	1.202	+23.00%	+19.16% to +27.05%
Fish S2-Pro	Reset · hard joins	64	log_mel	58	0.4071	+22.33%	+19.11% to +25.69%
Fish S2-Pro	Reset · hard joins	64	log1p_mel	58	0.006336	+43.18%	+36.62% to +50.59%
Fish S2-Pro	Replay 32 · Hann 50%	64	mr_stft	58	1.042	+6.65%	+4.96% to +8.53%
Fish S2-Pro	Replay 32 · Hann 50%	64	log_mel	58	0.3567	+7.19%	+5.58% to +8.92%
Fish S2-Pro	Replay 32 · Hann 50%	64	log1p_mel	58	0.004989	+12.75%	+9.97% to +15.65%
Fish S2-Pro	Replay 32 · hard joins	64	mr_stft	58	1.065	+8.99%	+6.81% to +11.37%
Fish S2-Pro	Replay 32 · hard joins	64	log_mel	58	0.3622	+8.85%	+6.92% to +10.84%
Fish S2-Pro	Replay 32 · hard joins	64	log1p_mel	58	0.005147	+16.31%	+12.91% to +20.30%
Qwen 12Hz	All state · hard joins	1	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	1	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	1	log1p_mel	60	0.004916	+0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · hard joins	1	mr_stft	60	1.473	+32.87%	+28.97% to +37.03%
Qwen 12Hz	Conv only · hard joins	1	log_mel	60	0.5169	+42.22%	+38.59% to +45.97%
Qwen 12Hz	Conv only · hard joins	1	log1p_mel	60	0.008258	+67.98%	+57.53% to +80.02%
Qwen 12Hz	KV only · hard joins	1	mr_stft	60	1.735	+56.51%	+52.19% to +61.01%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Qwen 12Hz	KV only · hard joins	1	log_mel	60	0.7023	+93.26%	+86.97% to +99.65%
Qwen 12Hz	KV only · hard joins	1	log1p_mel	60	0.01127	+129.23%	+114.75% to +146.53%
Qwen 12Hz	Reset · hard joins	1	mr_stft	60	1.945	+75.47%	+70.32% to +80.76%
Qwen 12Hz	Reset · hard joins	1	log_mel	60	0.817	+124.82%	+117.44% to +132.35%
Qwen 12Hz	Reset · hard joins	1	log1p_mel	60	0.01328	+170.18%	+151.19% to +192.58%
Qwen 12Hz	Replay 32 · hard joins	1	mr_stft	60	1.137	+2.56%	+1.73% to +3.61%
Qwen 12Hz	Replay 32 · hard joins	1	log_mel	60	0.3754	+3.31%	+2.39% to +4.42%
Qwen 12Hz	Replay 32 · hard joins	1	log1p_mel	60	0.005134	+4.42%	+3.04% to +5.96%
Qwen 12Hz	All state · Hann 50%	2	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	2	log_mel	60	0.3634	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	2	log1p_mel	60	0.004916	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	2	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	2	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	2	log1p_mel	60	0.004916	+0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · Hann 50%	2	mr_stft	60	1.461	+31.84%	+28.05% to +35.87%
Qwen 12Hz	Conv only · Hann 50%	2	log_mel	60	0.5162	+42.05%	+38.65% to +45.71%
Qwen 12Hz	Conv only · Hann 50%	2	log1p_mel	60	0.008155	+65.88%	+55.80% to +77.11%
Qwen 12Hz	Conv only · hard joins	2	mr_stft	60	1.444	+30.25%	+26.69% to +34.22%
Qwen 12Hz	Conv only · hard joins	2	log_mel	60	0.5007	+37.79%	+34.42% to +41.37%
Qwen 12Hz	Conv only · hard joins	2	log1p_mel	60	0.007958	+61.87%	+52.20% to +72.74%
Qwen 12Hz	KV only · Hann 50%	2	mr_stft	60	1.308	+17.96%	+14.79% to +21.40%
Qwen 12Hz	KV only · Hann 50%	2	log_mel	60	0.4693	+29.14%	+24.98% to +33.77%
Qwen 12Hz	KV only · Hann 50%	2	log1p_mel	60	0.007339	+49.28%	+41.62% to +58.27%
Qwen 12Hz	KV only · hard joins	2	mr_stft	60	1.464	+32.11%	+29.26% to +35.05%
Qwen 12Hz	KV only · hard joins	2	log_mel	60	0.5423	+49.24%	+45.44% to +53.12%
Qwen 12Hz	KV only · hard joins	2	log1p_mel	60	0.008253	+67.86%	+59.81% to +77.16%
Qwen 12Hz	Reset · Hann 50%	2	mr_stft	60	1.579	+42.49%	+37.61% to +47.73%
Qwen 12Hz	Reset · Hann 50%	2	log_mel	60	0.6015	+65.52%	+59.37% to +71.76%
Qwen 12Hz	Reset · Hann 50%	2	log1p_mel	60	0.009893	+101.23%	+86.78% to +118.29%
Qwen 12Hz	Reset · hard joins	2	mr_stft	60	1.749	+57.82%	+53.03% to +62.80%
Qwen 12Hz	Reset · hard joins	2	log_mel	60	0.6811	+87.41%	+81.46% to +93.61%
Qwen 12Hz	Reset · hard joins	2	log1p_mel	60	0.01119	+127.65%	+112.00% to +146.36%
Qwen 12Hz	Replay 32 · Hann 50%	2	mr_stft	60	1.133	+2.24%	+1.59% to +3.05%
Qwen 12Hz	Replay 32 · Hann 50%	2	log_mel	60	0.3741	+2.93%	+2.16% to +3.85%
Qwen 12Hz	Replay 32 · Hann 50%	2	log1p_mel	60	0.005127	+4.29%	+2.90% to +5.81%
Qwen 12Hz	Replay 32 · hard joins	2	mr_stft	60	1.136	+2.47%	+1.67% to +3.48%
Qwen 12Hz	Replay 32 · hard joins	2	log_mel	60	0.3749	+3.17%	+2.27% to +4.22%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Qwen 12Hz	Replay 32 · hard joins	2	log1p_mel	60	0.005127	+4.29%	+2.91% to +5.78%
Qwen 12Hz	All state · Hann 50%	4	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	4	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	4	log1p_mel	60	0.004916	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	4	mr_stft	60	1.108	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	4	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	4	log1p_mel	60	0.004916	-0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · Hann 50%	4	mr_stft	60	1.408	+27.02%	+23.74% to +30.61%
Qwen 12Hz	Conv only · Hann 50%	4	log_mel	60	0.4897	+34.74%	+31.51% to +38.15%
Qwen 12Hz	Conv only · Hann 50%	4	log1p_mel	60	0.007713	+56.89%	+47.97% to +66.76%
Qwen 12Hz	Conv only · hard joins	4	mr_stft	60	1.402	+26.51%	+23.29% to +30.03%
Qwen 12Hz	Conv only · hard joins	4	log_mel	60	0.4781	+31.56%	+28.93% to +34.38%
Qwen 12Hz	Conv only · hard joins	4	log1p_mel	60	0.007555	+53.67%	+45.00% to +63.82%
Qwen 12Hz	KV only · Hann 50%	4	mr_stft	60	1.146	+3.37%	+2.66% to +4.13%
Qwen 12Hz	KV only · Hann 50%	4	log_mel	60	0.3869	+6.46%	+5.45% to +7.49%
Qwen 12Hz	KV only · Hann 50%	4	log1p_mel	60	0.005375	+9.33%	+7.56% to +11.16%
Qwen 12Hz	KV only · hard joins	4	mr_stft	60	1.3	+17.27%	+15.43% to +19.17%
Qwen 12Hz	KV only · hard joins	4	log_mel	60	0.448	+23.27%	+21.44% to +25.18%
Qwen 12Hz	KV only · hard joins	4	log1p_mel	60	0.00656	+33.44%	+28.93% to +38.55%
Qwen 12Hz	Reset · Hann 50%	4	mr_stft	60	1.461	+31.84%	+27.78% to +36.20%
Qwen 12Hz	Reset · Hann 50%	4	log_mel	60	0.5218	+43.58%	+39.08% to +48.34%
Qwen 12Hz	Reset · Hann 50%	4	log1p_mel	60	0.008505	+73.00%	+61.16% to +86.12%
Qwen 12Hz	Reset · hard joins	4	mr_stft	60	1.584	+42.87%	+38.81% to +47.14%
Qwen 12Hz	Reset · hard joins	4	log_mel	60	0.574	+57.94%	+53.36% to +62.68%
Qwen 12Hz	Reset · hard joins	4	log1p_mel	60	0.009391	+91.02%	+78.53% to +105.55%
Qwen 12Hz	Replay 32 · Hann 50%	4	mr_stft	60	1.132	+2.14%	+1.49% to +2.94%
Qwen 12Hz	Replay 32 · Hann 50%	4	log_mel	60	0.3736	+2.80%	+2.04% to +3.69%
Qwen 12Hz	Replay 32 · Hann 50%	4	log1p_mel	60	0.005115	+4.03%	+2.67% to +5.55%
Qwen 12Hz	Replay 32 · hard joins	4	mr_stft	60	1.134	+2.33%	+1.62% to +3.23%
Qwen 12Hz	Replay 32 · hard joins	4	log_mel	60	0.3743	+3.00%	+2.18% to +4.00%
Qwen 12Hz	Replay 32 · hard joins	4	log1p_mel	60	0.005118	+4.10%	+2.76% to +5.58%
Qwen 12Hz	All state · Hann 50%	8	mr_stft	60	1.108	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	8	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	8	log1p_mel	60	0.004916	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	8	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	8	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	8	log1p_mel	60	0.004916	-0.00%	-0.00% to +0.00%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Qwen 12Hz	Conv only · Hann 50%	8	mr_stft	60	1.336	+20.56%	+17.63% to +23.78%
Qwen 12Hz	Conv only · Hann 50%	8	log_mel	60	0.4565	+25.60%	+22.98% to +28.35%
Qwen 12Hz	Conv only · Hann 50%	8	log1p_mel	60	0.007046	+43.32%	+35.42% to +51.82%
Qwen 12Hz	Conv only · hard joins	8	mr_stft	60	1.337	+20.61%	+17.74% to +23.75%
Qwen 12Hz	Conv only · hard joins	8	log_mel	60	0.4486	+23.44%	+20.96% to +26.07%
Qwen 12Hz	Conv only · hard joins	8	log1p_mel	60	0.00692	+40.76%	+33.03% to +49.58%
Qwen 12Hz	KV only · Hann 50%	8	mr_stft	60	1.114	+0.53%	+0.35% to +0.75%
Qwen 12Hz	KV only · Hann 50%	8	log_mel	60	0.3684	+1.36%	+1.11% to +1.61%
Qwen 12Hz	KV only · Hann 50%	8	log1p_mel	60	0.004981	+1.32%	+0.86% to +1.80%
Qwen 12Hz	KV only · hard joins	8	mr_stft	60	1.21	+9.19%	+8.03% to +10.40%
Qwen 12Hz	KV only · hard joins	8	log_mel	60	0.4038	+11.11%	+10.07% to +12.19%
Qwen 12Hz	KV only · hard joins	8	log1p_mel	60	0.005769	+17.36%	+14.71% to +20.22%
Qwen 12Hz	Reset · Hann 50%	8	mr_stft	60	1.357	+22.47%	+19.25% to +25.97%
Qwen 12Hz	Reset · Hann 50%	8	log_mel	60	0.4677	+28.70%	+25.54% to +31.94%
Qwen 12Hz	Reset · Hann 50%	8	log1p_mel	60	0.007355	+49.60%	+40.73% to +59.74%
Qwen 12Hz	Reset · hard joins	8	mr_stft	60	1.447	+30.54%	+26.97% to +34.30%
Qwen 12Hz	Reset · hard joins	8	log_mel	60	0.4989	+37.27%	+33.70% to +41.19%
Qwen 12Hz	Reset · hard joins	8	log1p_mel	60	0.007999	+62.71%	+52.61% to +73.96%
Qwen 12Hz	Replay 32 · Hann 50%	8	mr_stft	60	1.13	+1.94%	+1.33% to +2.68%
Qwen 12Hz	Replay 32 · Hann 50%	8	log_mel	60	0.3727	+2.55%	+1.84% to +3.38%
Qwen 12Hz	Replay 32 · Hann 50%	8	log1p_mel	60	0.005096	+3.65%	+2.35% to +5.13%
Qwen 12Hz	Replay 32 · hard joins	8	mr_stft	60	1.132	+2.13%	+1.44% to +2.95%
Qwen 12Hz	Replay 32 · hard joins	8	log_mel	60	0.373	+2.65%	+1.89% to +3.57%
Qwen 12Hz	Replay 32 · hard joins	8	log1p_mel	60	0.005099	+3.72%	+2.43% to +5.16%
Qwen 12Hz	All state · Hann 50%	12	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	12	log_mel	60	0.3634	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	12	log1p_mel	60	0.004916	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	12	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	12	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	12	log1p_mel	60	0.004916	+0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · Hann 50%	12	mr_stft	60	1.287	+16.10%	+13.45% to +18.99%
Qwen 12Hz	Conv only · Hann 50%	12	log_mel	60	0.4358	+19.92%	+17.37% to +22.62%
Qwen 12Hz	Conv only · Hann 50%	12	log1p_mel	60	0.006558	+33.39%	+26.78% to +41.07%
Qwen 12Hz	Conv only · hard joins	12	mr_stft	60	1.296	+16.92%	+14.44% to +19.64%
Qwen 12Hz	Conv only · hard joins	12	log_mel	60	0.4346	+19.58%	+17.50% to +21.85%
Qwen 12Hz	Conv only · hard joins	12	log1p_mel	60	0.006525	+32.73%	+26.38% to +39.90%
Qwen 12Hz	KV only · Hann 50%	12	mr_stft	60	1.112	+0.29%	+0.19% to +0.41%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Qwen 12Hz	KV only · Hann 50%	12	log_mel	60	0.3658	+0.65%	+0.52% to +0.79%
Qwen 12Hz	KV only · Hann 50%	12	log1p_mel	60	0.004951	+0.70%	+0.45% to +0.97%
Qwen 12Hz	KV only · hard joins	12	mr_stft	60	1.172	+5.74%	+4.72% to +6.87%
Qwen 12Hz	KV only · hard joins	12	log_mel	60	0.3883	+6.85%	+6.14% to +7.60%
Qwen 12Hz	KV only · hard joins	12	log1p_mel	60	0.005417	+10.19%	+8.58% to +12.06%
Qwen 12Hz	Reset · Hann 50%	12	mr_stft	60	1.304	+17.62%	+14.80% to +20.70%
Qwen 12Hz	Reset · Hann 50%	12	log_mel	60	0.4437	+22.09%	+19.35% to +25.00%
Qwen 12Hz	Reset · Hann 50%	12	log1p_mel	60	0.006757	+37.45%	+29.74% to +46.27%
Qwen 12Hz	Reset · hard joins	12	mr_stft	60	1.372	+23.81%	+20.74% to +27.21%
Qwen 12Hz	Reset · hard joins	12	log_mel	60	0.4659	+28.19%	+25.24% to +31.24%
Qwen 12Hz	Reset · hard joins	12	log1p_mel	60	0.007255	+47.58%	+38.95% to +57.24%
Qwen 12Hz	Replay 32 · Hann 50%	12	mr_stft	60	1.128	+1.78%	+1.18% to +2.51%
Qwen 12Hz	Replay 32 · Hann 50%	12	log_mel	60	0.372	+2.36%	+1.67% to +3.13%
Qwen 12Hz	Replay 32 · Hann 50%	12	log1p_mel	60	0.005079	+3.32%	+2.13% to +4.62%
Qwen 12Hz	Replay 32 · hard joins	12	mr_stft	60	1.129	+1.90%	+1.25% to +2.68%
Qwen 12Hz	Replay 32 · hard joins	12	log_mel	60	0.372	+2.37%	+1.67% to +3.20%
Qwen 12Hz	Replay 32 · hard joins	12	log1p_mel	60	0.005088	+3.49%	+2.28% to +4.78%
Qwen 12Hz	All state · Hann 50%	16	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	16	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	16	log1p_mel	60	0.004916	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	16	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	16	log_mel	60	0.3634	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	16	log1p_mel	60	0.004916	-0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · Hann 50%	16	mr_stft	60	1.254	+13.17%	+10.79% to +15.69%
Qwen 12Hz	Conv only · Hann 50%	16	log_mel	60	0.4234	+16.52%	+14.22% to +19.00%
Qwen 12Hz	Conv only · Hann 50%	16	log1p_mel	60	0.006259	+27.32%	+21.50% to +33.81%
Qwen 12Hz	Conv only · hard joins	16	mr_stft	60	1.27	+14.59%	+11.98% to +17.31%
Qwen 12Hz	Conv only · hard joins	16	log_mel	60	0.4234	+16.52%	+14.21% to +18.99%
Qwen 12Hz	Conv only · hard joins	16	log1p_mel	60	0.006291	+27.96%	+21.77% to +34.72%
Qwen 12Hz	KV only · Hann 50%	16	mr_stft	60	1.11	+0.13%	+0.06% to +0.22%
Qwen 12Hz	KV only · Hann 50%	16	log_mel	60	0.3646	+0.33%	+0.19% to +0.48%
Qwen 12Hz	KV only · Hann 50%	16	log1p_mel	60	0.004934	+0.35%	+0.14% to +0.57%
Qwen 12Hz	KV only · hard joins	16	mr_stft	60	1.151	+3.88%	+3.24% to +4.59%
Qwen 12Hz	KV only · hard joins	16	log_mel	60	0.382	+5.11%	+4.45% to +5.82%
Qwen 12Hz	KV only · hard joins	16	log1p_mel	60	0.005277	+7.33%	+5.99% to +8.87%
Qwen 12Hz	Reset · Hann 50%	16	mr_stft	60	1.267	+14.28%	+11.72% to +17.13%
Qwen 12Hz	Reset · Hann 50%	16	log_mel	60	0.429	+18.06%	+15.45% to +20.86%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Qwen 12Hz	Reset · Hann 50%	16	log1p_mel	60	0.006415	+30.48%	+23.65% to +37.96%
Qwen 12Hz	Reset · hard joins	16	mr_stft	60	1.323	+19.38%	+16.34% to +22.58%
Qwen 12Hz	Reset · hard joins	16	log_mel	60	0.4474	+23.11%	+20.37% to +26.08%
Qwen 12Hz	Reset · hard joins	16	log1p_mel	60	0.006799	+38.30%	+30.63% to +46.93%
Qwen 12Hz	Replay 32 · Hann 50%	16	mr_stft	60	1.127	+1.65%	+1.11% to +2.31%
Qwen 12Hz	Replay 32 · Hann 50%	16	log_mel	60	0.3712	+2.13%	+1.50% to +2.90%
Qwen 12Hz	Replay 32 · Hann 50%	16	log1p_mel	60	0.005067	+3.07%	+1.91% to +4.40%
Qwen 12Hz	Replay 32 · hard joins	16	mr_stft	60	1.127	+1.66%	+1.14% to +2.27%
Qwen 12Hz	Replay 32 · hard joins	16	log_mel	60	0.3709	+2.05%	+1.46% to +2.73%
Qwen 12Hz	Replay 32 · hard joins	16	log1p_mel	60	0.005058	+2.87%	+1.91% to +3.92%
Qwen 12Hz	All state · Hann 50%	24	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	24	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	24	log1p_mel	60	0.004916	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	24	mr_stft	60	1.108	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	24	log_mel	60	0.3634	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	24	log1p_mel	60	0.004916	-0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · Hann 50%	24	mr_stft	60	1.212	+9.37%	+7.72% to +11.23%
Qwen 12Hz	Conv only · Hann 50%	24	log_mel	60	0.4084	+12.39%	+10.72% to +14.17%
Qwen 12Hz	Conv only · Hann 50%	24	log1p_mel	60	0.005871	+19.42%	+14.89% to +24.69%
Qwen 12Hz	Conv only · hard joins	24	mr_stft	60	1.223	+10.33%	+8.52% to +12.41%
Qwen 12Hz	Conv only · hard joins	24	log_mel	60	0.4074	+12.09%	+10.41% to +13.86%
Qwen 12Hz	Conv only · hard joins	24	log1p_mel	60	0.005911	+20.22%	+15.94% to +24.92%
Qwen 12Hz	KV only · Hann 50%	24	mr_stft	60	1.11	+0.13%	+0.06% to +0.24%
Qwen 12Hz	KV only · Hann 50%	24	log_mel	60	0.3646	+0.32%	+0.19% to +0.48%
Qwen 12Hz	KV only · Hann 50%	24	log1p_mel	60	0.004933	+0.34%	+0.18% to +0.56%
Qwen 12Hz	KV only · hard joins	24	mr_stft	60	1.137	+2.57%	+2.02% to +3.22%
Qwen 12Hz	KV only · hard joins	24	log_mel	60	0.3742	+2.96%	+2.55% to +3.40%
Qwen 12Hz	KV only · hard joins	24	log1p_mel	60	0.005159	+4.93%	+3.97% to +6.02%
Qwen 12Hz	Reset · Hann 50%	24	mr_stft	60	1.222	+10.20%	+8.38% to +12.18%
Qwen 12Hz	Reset · Hann 50%	24	log_mel	60	0.4127	+13.56%	+11.75% to +15.49%
Qwen 12Hz	Reset · Hann 50%	24	log1p_mel	60	0.005968	+21.39%	+16.22% to +27.31%
Qwen 12Hz	Reset · hard joins	24	mr_stft	60	1.259	+13.59%	+11.44% to +15.90%
Qwen 12Hz	Reset · hard joins	24	log_mel	60	0.421	+15.85%	+13.84% to +17.96%
Qwen 12Hz	Reset · hard joins	24	log1p_mel	60	0.006241	+26.94%	+21.74% to +32.71%
Qwen 12Hz	Replay 32 · Hann 50%	24	mr_stft	60	1.124	+1.43%	+0.92% to +2.09%
Qwen 12Hz	Replay 32 · Hann 50%	24	log_mel	60	0.3703	+1.89%	+1.31% to +2.60%
Qwen 12Hz	Replay 32 · Hann 50%	24	log1p_mel	60	0.005053	+2.78%	+1.67% to +4.06%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Qwen 12Hz	Replay 32 · hard joins	24	mr_stft	60	1.126	+1.59%	+1.00% to +2.37%
Qwen 12Hz	Replay 32 · hard joins	24	log_mel	60	0.3704	+1.93%	+1.29% to +2.77%
Qwen 12Hz	Replay 32 · hard joins	24	log1p_mel	60	0.005056	+2.83%	+1.78% to +4.07%
Qwen 12Hz	All state · Hann 50%	32	mr_stft	58	1.103	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	32	log_mel	58	0.3615	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	32	log1p_mel	58	0.004921	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	32	mr_stft	58	1.103	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	32	log_mel	58	0.3615	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	32	log1p_mel	58	0.004921	-0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · Hann 50%	32	mr_stft	58	1.188	+7.71%	+6.21% to +9.31%
Qwen 12Hz	Conv only · Hann 50%	32	log_mel	58	0.4001	+10.67%	+8.99% to +12.48%
Qwen 12Hz	Conv only · Hann 50%	32	log1p_mel	58	0.005686	+15.55%	+11.67% to +19.88%
Qwen 12Hz	Conv only · hard joins	32	mr_stft	58	1.2	+8.76%	+7.02% to +10.69%
Qwen 12Hz	Conv only · hard joins	32	log_mel	58	0.3976	+9.97%	+8.51% to +11.51%
Qwen 12Hz	Conv only · hard joins	32	log1p_mel	58	0.00576	+17.04%	+12.74% to +21.79%
Qwen 12Hz	KV only · Hann 50%	32	mr_stft	58	1.104	+0.10%	+0.04% to +0.19%
Qwen 12Hz	KV only · Hann 50%	32	log_mel	58	0.3622	+0.19%	+0.07% to +0.35%
Qwen 12Hz	KV only · Hann 50%	32	log1p_mel	58	0.004934	+0.27%	+0.10% to +0.52%
Qwen 12Hz	KV only · hard joins	32	mr_stft	58	1.121	+1.58%	+1.17% to +2.10%
Qwen 12Hz	KV only · hard joins	32	log_mel	58	0.3692	+2.11%	+1.76% to +2.52%
Qwen 12Hz	KV only · hard joins	32	log1p_mel	58	0.005072	+3.07%	+2.36% to +4.01%
Qwen 12Hz	Reset · Hann 50%	32	mr_stft	58	1.193	+8.10%	+6.52% to +9.83%
Qwen 12Hz	Reset · Hann 50%	32	log_mel	58	0.4022	+11.25%	+9.38% to +13.23%
Qwen 12Hz	Reset · Hann 50%	32	log1p_mel	58	0.005736	+16.55%	+12.43% to +21.03%
Qwen 12Hz	Reset · hard joins	32	mr_stft	58	1.225	+11.00%	+9.01% to +13.22%
Qwen 12Hz	Reset · hard joins	32	log_mel	58	0.4083	+12.94%	+11.27% to +14.72%
Qwen 12Hz	Reset · hard joins	32	log1p_mel	58	0.005986	+21.64%	+16.60% to +27.25%
Qwen 12Hz	Replay 32 · Hann 50%	32	mr_stft	58	1.117	+1.24%	+0.83% to +1.69%
Qwen 12Hz	Replay 32 · Hann 50%	32	log_mel	58	0.3674	+1.62%	+1.12% to +2.19%
Qwen 12Hz	Replay 32 · Hann 50%	32	log1p_mel	58	0.005032	+2.24%	+1.43% to +3.15%
Qwen 12Hz	Replay 32 · hard joins	32	mr_stft	58	1.116	+1.17%	+0.75% to +1.67%
Qwen 12Hz	Replay 32 · hard joins	32	log_mel	58	0.3664	+1.34%	+0.85% to +1.93%
Qwen 12Hz	Replay 32 · hard joins	32	log1p_mel	58	0.005013	+1.86%	+1.15% to +2.67%
Qwen 12Hz	All state · Hann 50%	48	mr_stft	50	1.098	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	48	log_mel	50	0.3624	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	48	log1p_mel	50	0.005017	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	48	mr_stft	50	1.098	+0.00%	-0.00% to +0.00%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Qwen 12Hz	All state · hard joins	48	log_mel	50	0.3624	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	48	log1p_mel	50	0.005017	-0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · Hann 50%	48	mr_stft	50	1.157	+5.44%	+4.48% to +6.58%
Qwen 12Hz	Conv only · Hann 50%	48	log_mel	50	0.3913	+7.96%	+6.88% to +9.14%
Qwen 12Hz	Conv only · Hann 50%	48	log1p_mel	50	0.005598	+11.57%	+8.70% to +14.93%
Qwen 12Hz	Conv only · hard joins	48	mr_stft	50	1.165	+6.17%	+4.72% to +7.84%
Qwen 12Hz	Conv only · hard joins	48	log_mel	50	0.3885	+7.19%	+5.95% to +8.56%
Qwen 12Hz	Conv only · hard joins	48	log1p_mel	50	0.00563	+12.21%	+9.09% to +15.76%
Qwen 12Hz	KV only · Hann 50%	48	mr_stft	50	1.099	+0.11%	+0.04% to +0.23%
Qwen 12Hz	KV only · Hann 50%	48	log_mel	50	0.3632	+0.23%	+0.08% to +0.43%
Qwen 12Hz	KV only · Hann 50%	48	log1p_mel	50	0.005033	+0.31%	+0.11% to +0.64%
Qwen 12Hz	KV only · hard joins	48	mr_stft	50	1.111	+1.17%	+0.85% to +1.53%
Qwen 12Hz	KV only · hard joins	48	log_mel	50	0.3683	+1.61%	+1.33% to +1.93%
Qwen 12Hz	KV only · hard joins	48	log1p_mel	50	0.005135	+2.35%	+1.70% to +3.15%
Qwen 12Hz	Reset · Hann 50%	48	mr_stft	50	1.163	+5.92%	+4.88% to +7.12%
Qwen 12Hz	Reset · Hann 50%	48	log_mel	50	0.3936	+8.60%	+7.46% to +9.81%
Qwen 12Hz	Reset · Hann 50%	48	log1p_mel	50	0.005642	+12.45%	+9.36% to +15.95%
Qwen 12Hz	Reset · hard joins	48	mr_stft	50	1.186	+8.07%	+6.48% to +9.89%
Qwen 12Hz	Reset · hard joins	48	log_mel	50	0.397	+9.54%	+8.10% to +10.99%
Qwen 12Hz	Reset · hard joins	48	log1p_mel	50	0.005816	+15.92%	+12.39% to +19.81%
Qwen 12Hz	Replay 32 · Hann 50%	48	mr_stft	50	1.112	+1.33%	+0.82% to +2.07%
Qwen 12Hz	Replay 32 · Hann 50%	48	log_mel	50	0.3685	+1.69%	+1.07% to +2.48%
Qwen 12Hz	Replay 32 · Hann 50%	48	log1p_mel	50	0.005127	+2.19%	+1.26% to +3.31%
Qwen 12Hz	Replay 32 · hard joins	48	mr_stft	50	1.116	+1.63%	+0.96% to +2.62%
Qwen 12Hz	Replay 32 · hard joins	48	log_mel	50	0.369	+1.83%	+1.20% to +2.67%
Qwen 12Hz	Replay 32 · hard joins	48	log1p_mel	50	0.005137	+2.38%	+1.44% to +3.62%
Qwen 12Hz	All state · Hann 50%	64	mr_stft	30	1.094	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	64	log_mel	30	0.3542	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · Hann 50%	64	log1p_mel	30	0.006146	+0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	64	mr_stft	30	1.094	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	64	log_mel	30	0.3542	-0.00%	-0.00% to +0.00%
Qwen 12Hz	All state · hard joins	64	log1p_mel	30	0.006146	-0.00%	-0.00% to +0.00%
Qwen 12Hz	Conv only · Hann 50%	64	mr_stft	30	1.146	+4.78%	+4.02% to +5.60%
Qwen 12Hz	Conv only · Hann 50%	64	log_mel	30	0.3788	+6.94%	+5.90% to +8.04%
Qwen 12Hz	Conv only · Hann 50%	64	log1p_mel	30	0.006714	+9.24%	+6.72% to +12.12%
Qwen 12Hz	Conv only · hard joins	64	mr_stft	30	1.156	+5.66%	+4.34% to +7.11%
Qwen 12Hz	Conv only · hard joins	64	log_mel	30	0.379	+6.99%	+5.43% to +8.69%

Codec	Policy	Frames	Metric	Clips	Absolute error	Added error	95% CI
Qwen 12Hz	Conv only · hard joins	64	log1p_mel	30	0.006635	+7.96%	+5.81% to +10.20%
Qwen 12Hz	KV only · Hann 50%	64	mr_stft	30	1.095	+0.08%	+0.02% to +0.19%
Qwen 12Hz	KV only · Hann 50%	64	log_mel	30	0.3547	+0.14%	+0.04% to +0.27%
Qwen 12Hz	KV only · Hann 50%	64	log1p_mel	30	0.006154	+0.12%	+0.04% to +0.26%
Qwen 12Hz	KV only · hard joins	64	mr_stft	30	1.103	+0.83%	+0.59% to +1.14%
Qwen 12Hz	KV only · hard joins	64	log_mel	30	0.3591	+1.39%	+1.04% to +1.78%
Qwen 12Hz	KV only · hard joins	64	log1p_mel	30	0.006237	+1.47%	+0.98% to +2.00%
Qwen 12Hz	Reset · Hann 50%	64	mr_stft	30	1.151	+5.28%	+4.43% to +6.23%
Qwen 12Hz	Reset · Hann 50%	64	log_mel	30	0.3807	+7.46%	+6.43% to +8.57%
Qwen 12Hz	Reset · Hann 50%	64	log1p_mel	30	0.006735	+9.58%	+6.97% to +12.52%
Qwen 12Hz	Reset · hard joins	64	mr_stft	30	1.169	+6.93%	+5.49% to +8.46%
Qwen 12Hz	Reset · hard joins	64	log_mel	30	0.384	+8.40%	+6.89% to +10.13%
Qwen 12Hz	Reset · hard joins	64	log1p_mel	30	0.006754	+9.88%	+7.24% to +12.85%
Qwen 12Hz	Replay 32 · Hann 50%	64	mr_stft	30	1.109	+1.41%	+0.96% to +1.97%
Qwen 12Hz	Replay 32 · Hann 50%	64	log_mel	30	0.3601	+1.66%	+1.13% to +2.33%
Qwen 12Hz	Replay 32 · Hann 50%	64	log1p_mel	30	0.006248	+1.65%	+1.00% to +2.42%
Qwen 12Hz	Replay 32 · hard joins	64	mr_stft	30	1.111	+1.62%	+1.23% to +2.01%
Qwen 12Hz	Replay 32 · hard joins	64	log_mel	30	0.3604	+1.73%	+1.30% to +2.18%
Qwen 12Hz	Replay 32 · hard joins	64	log1p_mel	30	0.006293	+2.39%	+1.47% to +3.40%