Technical Specifications

Audio format · pulse engineering · timing accuracy · loudness specification

∅1 PULSE ENGINEERING

The 40 Hz Pulse Train

Each track contains a 1,000 Hz pure sine wave pulsed on for 1 ms and off for 24 ms — completing
40 full cycles per second. This is the exact stimulus used in Wang et al. (PNAS, 2026) and the GENUS protocol.

Carrier frequency	**1,000** Hz	Pure sine wave
Pulse duration (ON)	**1** ms	1 millisecond per burst
Cycle period	**25** ms	40 cycles per second
Pulse duty cycle	**4** %	1 ms ON / 24 ms OFF
Repetition rate	**40.0000** Hz	Validated by FFT

⎵ 25 ms per cycle ⎵   10 cycles shown · actual rate: 40 / second

∅2 TIMING ACCURACY

Frequency Validation & Jitter

Pulse timing validated by FFT of the rendered audio file. Jitter = RMS deviation from ideal pulse centres,
measured across a full 60-minute render (144,000 events). Validation: scipy.signal.periodogram on 44,100 Hz render.

Pulse frequency accuracy	**±0.05** Hz	FFT bin resolution
Timing jitter (RMS)	**< 0.5** ms	Across 60-min render
Frequency drift	**0**	Static — no drift over session
Phase coherence	**Absolute**	Deterministic digital render

∅3 AUDIO FORMAT

Format & Encoding Specifications

Sample rate	**44,100** Hz		MP3 bitrate	**320** kbps
Bit depth	**16** bit		AAC bitrate	**256** kbps
Channels	**2** stereo		FLAC	**Lossless**
Session length	**60** minutes		WAV master	**16-bit** / 44.1 kHz
Fade-in	**2** min (after intro)		Loudness target	**−18** LUFS (ITU-R BS.1770-4)
Total pulses	**144,000** per session		Dynamic range	**DR14+**

∅4 LOUDNESS & STREAMING NORMALISATION

Platform Behaviour

Tracks are mastered at −18 LUFS. Streaming platforms apply loudness normalisation that can alter the pulse-to-ambient ratio.
Direct download (MP3/FLAC) plays the file as mastered — the recommended method for therapeutic use.

Platform	Target LUFS	Effect on Gamma40	Recommended?
Direct download	None (−18 LUFS)	No change — calibration preserved	Yes — primary
Bandcamp	None	No change	Yes — secondary
YouTube	−14 LUFS	Gain ~4 dB lower — slight impact	Awareness only
Spotify	−14 LUFS	Gain ~4 dB lower — pulse drops	Not recommended
Apple Music	−16 LUFS	Gain ~2 dB lower — minimal	Caution

Recommendation: Download MP3 or FLAC to your device and play locally.
Streaming normalisation alters the calibrated pulse-to-ambient level ratio.