

Sample rate, bit depth, the Nyquist rule, and raw PCM bitrates at a glance.

## The two dials

**Sample rate** How often you measure the wave. 48 kHz = 48,000 measurements/second. Standard for video.

**Bit depth** How precisely each measurement is stored. 16-bit = 65,536 levels; 24-bit = 16.7 million.

## Rules of thumb

- Nyquist: sample at least 2x the highest frequency you want to keep. 2 x 20 kHz = 40 kHz minimum.
- Dynamic range (dB) ~ 6.02 x bit depth + 1.76. 16-bit ~ 96 dB; 24-bit ~ 144 dB.
- Raw bitrate = sample rate x bit depth x channels.
- Higher numbers are not automatically better. Past 48 kHz / 16-bit you capture all the ear can hear.
- Use 32-bit float when recording or editing (headroom), not for final delivery.

## Raw PCM bitrate by use case

Use case	Sample rate	Bit depth	Channels	Raw bitrate
Telephone (G.711)	8 kHz	8-bit	mono	64 kbps
Conferencing (wideband)	16 kHz	16-bit	mono	256 kbps
<b>Video production</b>	48 kHz	24-bit	stereo	<b>2,304 kbps</b>
CD music	44.1 kHz	16-bit	stereo	1,411 kbps
Hi-res master	96 kHz	24-bit	stereo	4,608 kbps

### Worked example — CD-quality stereo

$44,100 \text{ samples/s} \times 16 \text{ bits} \times 2 \text{ channels} = 1,411,200 \text{ bits/s}$

$= 1,411 \text{ kbps} \sim 10 \text{ MB per minute of uncompressed audio.}$

*Codecs (AAC, Opus, MP3) shrink this PCM stream; the samples are what they compress.*