

Volume Pots vs Volume ICs



October 2021

Volume Pots

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Above: ZEN CAN

Volume Pot vs Volume IC

There has been a bit of discussion around the merits of physical volume control pots vs volume control ICs lately, in both the press and from a customer's viewpoint.

It's swings and roundabouts, of course! There are some things a volume pot is good at and others not so good. The good point would be sound quality. Not so good would be low-level channel tracking.

My background fiddling with circuits and volume controls is extensive and started when I heard a difference in the sound quality of a pot when I was about 16 at the Melbourne Audio Club. Quite a few DIY audiophiles' consensus at the club was that a volume pot has superior sound quality over an IC volume control. They (and I) have listened to a lot of volume pots over the years.

Hidden behind the facade of prestige is the desire to match the sound to their system, which highlights the fact that there are tonal differences between pots. One of the pots that had (and still has) a good set of attributes was the 9mm type as found in the ZEN CAN and other iFi units. My own experiments have taken me to fiddle with IC volume controls as well, and I have quite a few different ones in the IC drawer.

Both volume pots and IC pots have their quirks.

- Volume pots are able to be loaded down with the circuit they're driving without adding much extra distortion, and so are more transparent from the fact they don't need an extra amplifier stage, be it valve, discrete SS or IC op amp.
- IC volume controls can't be loaded down heavily with the following circuit as they produce a lot of extra distortion, necessitating the use of an extra buffer stage, with its own attendant sonic colouration. The IC pot consists of resistors that are connected to with the use of Mosfet switches, themselves adding distortion and nonlinear capacitance.

Generally, though, IC volume controls have superior channel tracking and repeatable volume control settings, and they change the level setting as the signal crosses through 0v so that no clicks are heard. That's why they are used in modern studio equipment and some hi-fi components, where their noiseless and easily implemented, compact and cost-effective operation is appreciated. Their family sound is slightly soft and a little more artificial than a physical volume control, and high attenuation can see them in their least sonically favourable light. Having said that though, given a transparent subsequent stage to drive they can be very good, and the IC volume control with high quality class A buffer in the AMR DP-777 is a good example.

There are quite a few different ways to change the volume these days. Transformer volume controls have the best signal-to-noise ratio, light-dependent resistors have nice sonics but poor tracking and worsening distortion at high attenuation levels.

Switched resistors have precision and sound quality on their side but can be expensive. The approach taken by the AMR AM-77 amplifier is microprocessor-controlled relays and resistors and is very transparent, with repeatable settings.

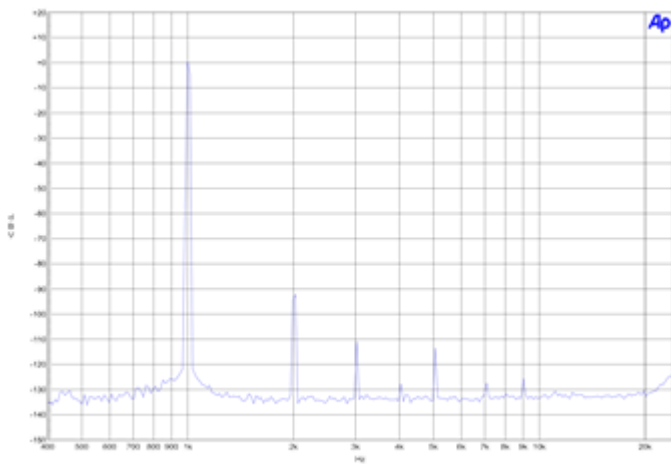
A digital-only system can have a purely digital volume control, but good ones can be expensive and must by design rely on the good linearity of the DAC chip and buffer stage for best sound quality.

For the ZEN CAN, a 9mm analogue pot was chosen as it provides a good measure of real transparency beyond its price point. The iFi Pro iDSD and Pro iCAN still use a volume control pot, but a physically larger type that has good tracking between the channels.

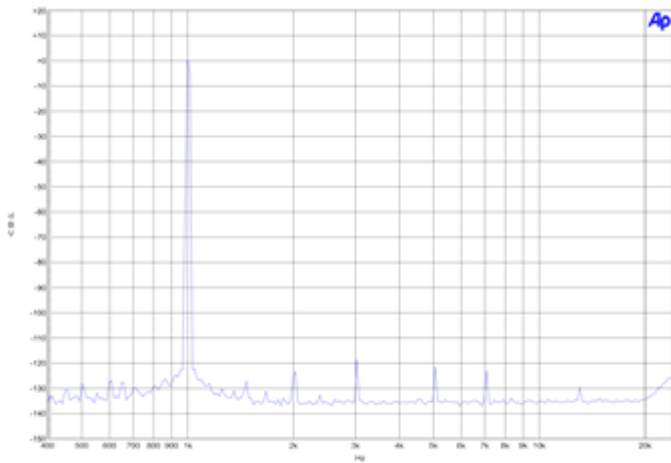
Also, you don't get the feel of turning a knob with an IC volume control either. It's more physically intuitive to turn a knob, and you can change volume much more quickly.

Addendum

Here are some measurements to show some difference between the 9mm pot and a typical volume control IC.

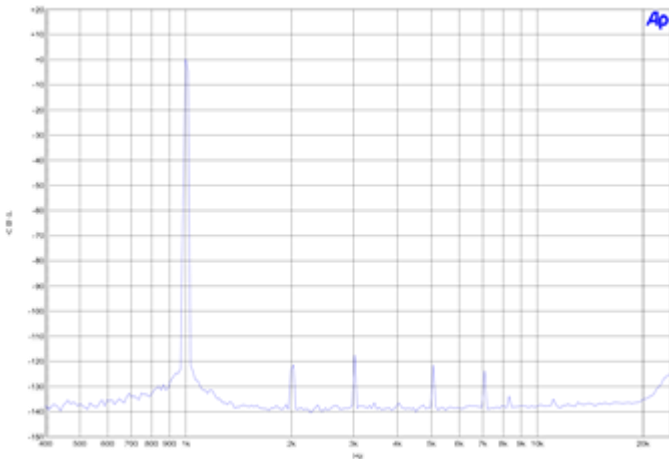


*Volume IC at -6dB with buffer.
The distortion is moderate.*



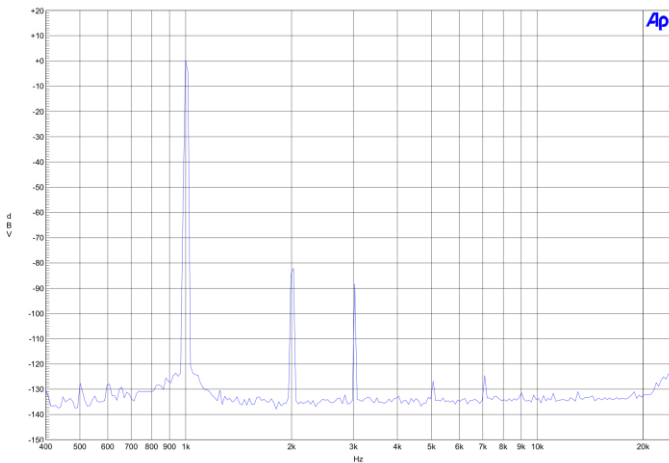
The 9mm 50k volume pot at half resistance, equivalent to the volume IC at -6dB.

You can see the distortion is minimal and approaches the limits of the Audio Precision (AP) which is impressive.



Here is the AP by itself with no volume control, measuring itself.

The distortion is about the same as that with the volume control! Noise floor is lower.



Just for comparison, here is the volume IC with no buffer and 100k loading.

Any loading increases distortion markedly, necessitating use of a buffer.

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iFi is the sister-brand of Abbingdon Music Research (AMR) and is headquartered in Southport, UK. The two brands respectively design and manufacture portable, desktop and lifestyle audio products and high-end hi-fi components. Combined in-house hardware and software development teams and a 'music first' approach enable iFi and AMR to create advanced audio products that deliver new levels of design, functionality and performance at their respective price points. Since iFi's formation in 2012, its products have earned many awards around the world, helping it to become one of the fastest-growing brands in its field.

