Tech note

Pro iCAN

True Differential Balanced®

At the upper end of the headphone amplifier market, despite the best protestations of 'balanced' things are not always what they seem. This is a curious case of 'Is balance balanced?'

For headphones, it DOES make good design sense to implement a balanced topology (the possibility of higher power, increase dynamic range and lower noise etc.) It goes without saying that the balanced design should be balanced all the way through, 'end-to-end.'

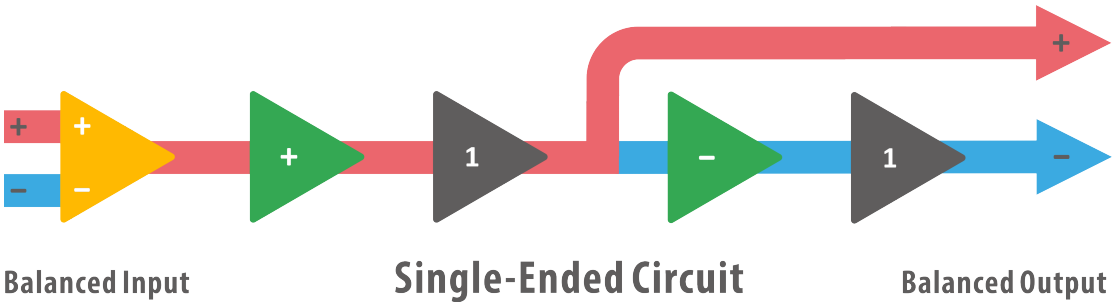
	Common high-end "Balanced" headphone amplifier	iFi Pro iCAN
Balanced Inputs/Outputs	●	●
Balanced Circuit (i.e. Differential)	-	●

1. The typical so-called 'Balanced' headphone amplifier

Input/Output: Balanced
Internal Circuitry: Single-Ended

The majority of 'balanced' high-ended headphone amplifiers are actually single-ended amplifiers with balanced inputs and outputs. The balanced input will be converted into single-ended operation inside the amplifier, then converted back to balanced just before the output:

The following block diagram depicts the balanced input through to the amplifier (orange) which afterwards, reverts to single-ended and runs through many single-ended stages before then going to the balanced outputs.



In detail: The balanced input signal will first be converted into single-ended operation by extra circuitry added to the single-ended signal path. The volume control and actual headphone amplifier are formed by a pure, single-ended circuit.

To provide balanced drive to the headphone, the signal is inverted using more circuitry added to the single-ended audio path.

> *A sure fire giveaway of such circuitry is the use of a 2-Deck volume control (c.f. 4-Deck for true balanced circuitry), as well as having more than four gain/current buffer blocks among two channels.*

At the input, the additional balanced to single-ended conversion circuit generates extra noise on top of the volume control pot.

At the output, the inverter circuit used to create the balanced signal simply doubles the signal, noise and distortion of the amplifier, nothing is reduced or cancelled, only added. So one gets double the signal but also double the noise and distortion.

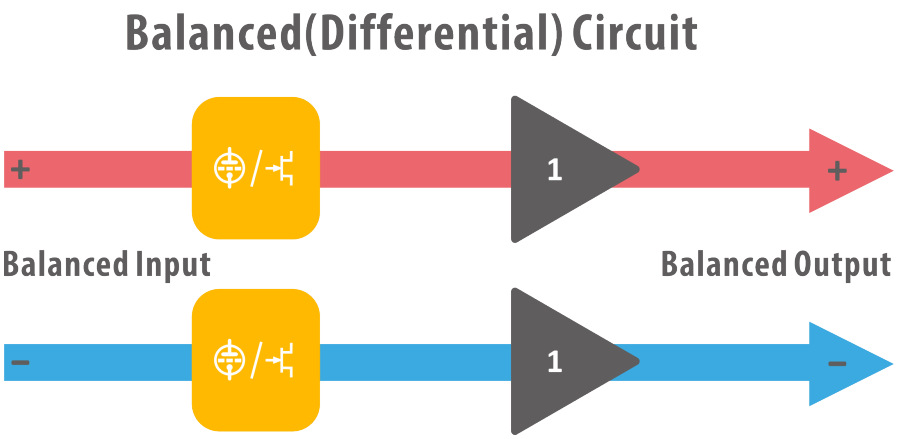
Hence this is truly a case where MORE IS LESS. There is much more circuitry, but far lesser performance, both objectively and subjectively.

2. *True Differential Balanced*® – Pro iCAN

Input/Output: Balanced
Internal Circuitry: Balanced

The Pro iCAN however, is true balanced end-to-end, from the input all the way through to the outputs. It operates with full-differential internal signaling, meaning the signal is always remains

two separate signals of equal level but opposite polarity. This is what we call True Differential Balanced®.



In detail: The Pro iCAN circuit is fully-balanced with completely equal circuit sections for Positive (Hot) and Negative (Cold) signal phase of each channel. The Volume control has 6-Decks, two decks each control the volume of one channel, and the other two decks are used for monitoring the volume control operation. This exceptional volume control potentiometer is custom made for iFi by ALPS Japan and has no parallel from other makers.

But, as the two halves of the volume control and the two halves of the amplification operate differentially, they effectively become a single stage. So the circuitry is highly elaborate in actual implementation, yet it comes down to the simplest design possible for a headphone amplifier, that is a volume control, a gain stage and a current buffer*.

Compared to a single-ended design with exactly the same circuit, True Differential Balanced® lowers noise by 3dB and also lowers THD dramatically over the. Additionally, it allows the signal level to be doubled, so True Differential Balanced® circuitry also produces 9dB (or 3 times) greater dynamic range.

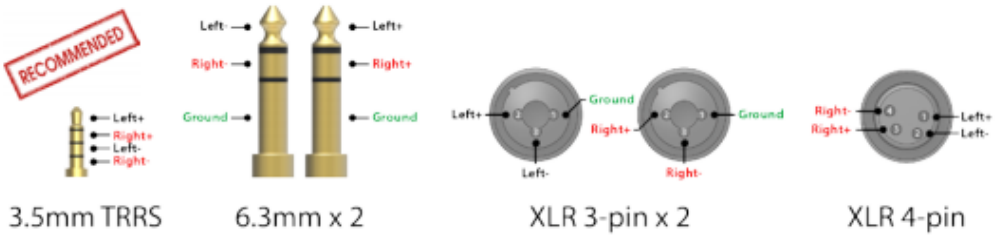
Note:
In professional audio, 'Balanced Amplifier' only means the Input/Output connections are balanced, the internal circuits are actually single-ended (if the internal circuit is also balanced, it will be called differential).

But in the Hi Fi world, most people view a 'Balanced Amplifier' as balanced all the way, from end-to-end, and incorrectly assume even the internal circuits are balanced.

3. The Balanced Connection

Pro iCAN has a range of balanced outputs, from XLR 4-pin all the way to 3.5 TRRS. At iFi, use 3.5 TRRS as the default and recommended balanced connection. The reason being

good quality connectors and sockets are widely available and it is also very portable, suitable for both over-the-head and in-ear headphones.



High-resolution photos & official logos: https://media.ifi-audio.com/portfolio/pro-ican/

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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.