

## iGalvanic3.0

### Part 1: The Holy Grail of Computer Audio

In the cavern full of cups scene (“The Last Crusade”), Indiana Jones had to choose the Holy Chalice used in the last supper.



In USB audio, similar propositions abound when selecting the best device to improve USB computer audio. The array of choices is mind boggling.

It is widely regarded that one of the most effective USB solutions is galvanic isolation. However, its scarcity reflects the technological hurdles that are not without issues of their own.

Having spent the best part of two years researching, (hence why we did not bring it out earlier!), we wholeheartedly agree. The iGalvanic3.0 has been one of our more ‘technologically challenging’ projects.

But the team at iFi audio are now over the moon to announce its arrival (albeit a tad later than expected).

The iGalvanic3.0 is one of a kind - able to deliver galvanic isolation on USB3.0 Super Speed. In a sea of USB audio improvement devices, the iGalvanic3.0 really is the ‘holy grail’.

We could have stopped work there and just brought the product to market. Yet, this is not in the AMR/iFi DNA. From this *starting point*, we spent more time developing additional features that truly make this product the ultimate solution for USB computer audio.



We believe the iGalvanic3.0 will elevate the quality of audio playback by an extreme magnitude.

## What is the iGalvanic3.0?



The iGalvanic3.0 is the one-stop USB audio enhancement solution for every computer audiophile. It offers the USB Trinity of:



- 
- I. REclock<sup>2</sup>/ REgenerate<sup>2</sup>/ REbalance<sup>2</sup>
  - +
  - II. Audiophile-grade USB3.0/2.0 Galvanic Isolation
  - +
  - III. Super-low noise USB power\*

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\*Measured noise is 0.5uV (0.000005V) @ 500mA load. Outperforms non-iFi USB devices. Bettered only by the micro iUSB3.0.

It is a ground-up, dedicated, stand-alone solution that elevates computer audio.



## **Tech Notes**

**August 2017**

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### **Who benefits from the iGalvanic3.0?**

Everyone who uses USB for computer audio but more specifically, the iGalvanic3.0 is the ideal solution to:

- 1) Break ground loops
- 2) Avoid noise-coupling in applications that require hi-speed USB transfers.

Thus, the iGalvanic3.0 is the perfect solution for computer audiophiles through to recording studios seeking maximum sound quality from their USB digital audio system.

## Part 2: Some are created Extra-Ordinary

There are three special aspects of the iGalvanic3.0 that in our opinion are unsurpassed:

- I. **'Double' REgenerate<sup>2</sup>/REclock<sup>2</sup>/REbalance<sup>2</sup>** before & after galvanic isolation.
- II. **USB3.0 and USB2.0 Galvanic Isolation** on the iFi USB platform.
- III. **Power Station<sup>o</sup> Stealth Converter** super-low noise audiophile USB power with Panasonic OsCons.

These are the three standout features of the iGalvanic3.0 but there are more which are covered in detail in this section.

### I. 'Double' REclock<sup>2</sup>/REgenerate<sup>2</sup>/REbalance<sup>2</sup>

REgen<sup>2</sup>  
REclock<sup>2</sup>  
REbalance<sup>2</sup>

From the development of the iUSB3.0 devices, we have the leading in-house know-how to improve the USB signal (and power). This is reflected in the iGalvanic3.0. Every data flow is regenerated subject to the iGalvanic3.0's own precision master clock system.

We did not stop there. Internal and external auditions - with ONE and TWO stage REgeneration versions of the iGalvanic3.0 – saw listeners unanimously prefer TWO sets of REgeneration.

Not being able to settle for one stage, the iGalvanic3.0 has TWO stages (before & after galvanic isolation) hence 'REgenerate<sup>2</sup>/REclock<sup>2</sup>/REbalance<sup>2</sup>' which goes 'above and beyond' other commercial projects.

This is clearly more expensive to implement and to the best of our knowledge, the iGalvanic3.0 is the only galvanic isolation product that has DOUBLE REgenerate<sup>2</sup>/REclock<sup>2</sup>/REbalance<sup>2</sup> because this was the ONLY way in our book.

### II. All-new USB3.0 galvanic isolation AND USB2.0 galvanic isolation





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The iGalvanic3.0 is the only product in the world to offer USB3.0 galvanic isolation. With separate transmitting AND receiving lines, it is superior to USB2.0 at handling high data volumes and is future-proofed.

The iGalvanic3.0 is the only galvanic isolation product suitable for Pro audio use where multichannel recording systems sees bandwidth 'hit the buffers' on USB2.0.

The iGalvanic3.0 is fully USB3.0 (and 2.0) standard compliant, with support for all speeds (from 1.5Mbps to 5Gbps) and all transfer modes (including isochronous audio streaming).



The iGalvanic3.0 features two distinctly separate galvanic isolation stages - one for USB3.0 and the other for USB2.0. They CANNOT be the same because the fundamental architecture is different:

- USB3.0 has separate transmitting AND receiving lines.
- USB2.0 is bi-directional on one SHARED line.

Both USB3.0 and USB2.0 galvanic isolation stages are ground-up, new platforms dedicated for computer audiophile systems and available to no-one else.

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USB2.0 Galvanic isolation technology (1st Gen) vs USB2.0 (AMR/iFi implementation)



The 1st generation is based upon SerDes (<https://en.wikipedia.org/wiki/SerDes>). This deconstruction and re-construction of the USB signal is far from ideal. Latency (timing), amongst other things, suffers.

At an early stage, AMR/iFi considered, then discarded, the SerDes platform - and developed a brand new platform. In our opinion, this is technologically superior.

*An Analogy: USB2.0 First Gen vs USB2.0 Next Gen*

*First generation implementation - SerDes*

*Imagine for a moment, selecting a route that has a bridge (galvanic isolation) that is too narrow for a lorry (USB audio signal) and cannot handle the weight of the lorry. At the bridge the lorry needs to be dismantled into pieces, the pieces need to be carried across and re-assembled on the other side.*

*The Next Generation - AMR/iFi implementation*

*The lorry takes a totally different route, one of a quiet, modern 4 lane bridge where the lorry just cruises across effortlessly.*

The advantages over first generation USB2.0 are:

- I. 100% transparent isolation - free from all the deconstructed and reconstructed, compatibility issues/challenges involved with the SerDes (USB2.0 bi-directional) approach.
  - II. Just 3 stages of USB Upstream/Isolation/Downstream - instead of 7 compared to 1st Generation USB2.0 isolation.
- 

### III. Audiophile power supply section, onboard.

**Power**  
**STATION**<sup>®</sup>  
**Stealth**  
**Converter**<sup>®</sup>

For ease of use and utility, the iGalvanic3.0 operates from USB Bus Power. A USB3.0 port is preferred as it is better constructed and supplies more power, 0.9mA (compared to 0.5A on USB2.0).

When operating from a USB3.0 or higher port, the iGalvanic3.0 can deliver up to 0.9A isolated low-noise power.

Measured noise is 0.5uV (0.0000005V) @ 500mA load. This is bettered only by the micro iUSB3.0 and comprehensively outclasses other non-iFi USB devices.

For the ultimate, we do not recommend an LPS as they are very costly yet offer little to no better noise performance. Instead, we recommend the iDefender & iPOWER (5v). Depending upon the type of system, it is possible to place the higher power supplied by the iDefender3.0/iPOWER combination BEFORE or AFTER the iGalvanic3.0 (see later for more details).

## IV. GroundLink to Major Hum.



Computer audio systems are a diverse lot. Different grounding schemes require different configurations. Knowing this means the iGalvanic3.0 is dedicated for serious computer audio use – it is able to suit different Ground/Earth setups to remove hum/buzz issues. From start to end, it is a ‘ground-up design’ (pun intended).

Specifically, the Ground link switch\* is to optimize isolation in systems where:

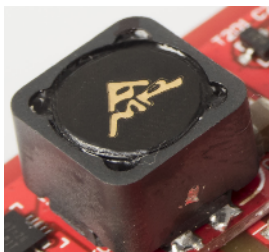
- Full Isolation (default – centre position)
- DC to RF soft ground-link (avoid hum in systems without Ground/Earth – up position)
- RF soft ground-link (avoid audio drop-outs in systems without RF Earth – down position)

\*Earth/Ground loops are commonly found and this switch deals with NO or Multiple Earths. It is best to start in the center position and then to try the other settings.

## IV. Unobtainium component? Let AMR sort.

The iGalvanic3.0 launch was delayed by several months because we could not produce in volume one atypical but integral component; a High-Frequency Power ‘HFP’ Transformer.

This is the actual ‘HFP’ Transformer in the iGalvanic3.0:



It is no ordinary power transformer because:

- I. Operating at high frequencies, it offers the best capacitance-to-noise ratio.  
ie. Being 10x smaller, it filters 10x better.
- II. Its noise floor is second-to-none; negligible compared to regular-sized counterpart.

Our German supplier could not produce them to the tight tolerances required. We spent the past few months searching for a transformer that met our strict requirements but it seems it does not exist.

Given the AMR/iFi philosophy, we were undeterred. When the going gets tough, the tough gets.....making. So we purchased the materials, equipment and hand-wound them in-house.



It is very difficult to manufacture:

- I. Pure 6N OFHC wire must be used.



- II. The winding MUST be hand-wound to a special configuration. Machine winding is nigh on impossible (yup, we tried).



- III. With the wire core complete, the shield is fitted and a special resin is injected.





IV. Then oven baked at 120° C for five mins. Here are some we made earlier.



With a width of 10mm only, it is tiny and therefore difficult to handle.

We had to call upon our considerable experience with audio transformers (starting way back with the AMR 77 transformers through to more recently, the Pro iESL) to make a power transformer that would work at the frequencies required for the Stealth Converter Technology.

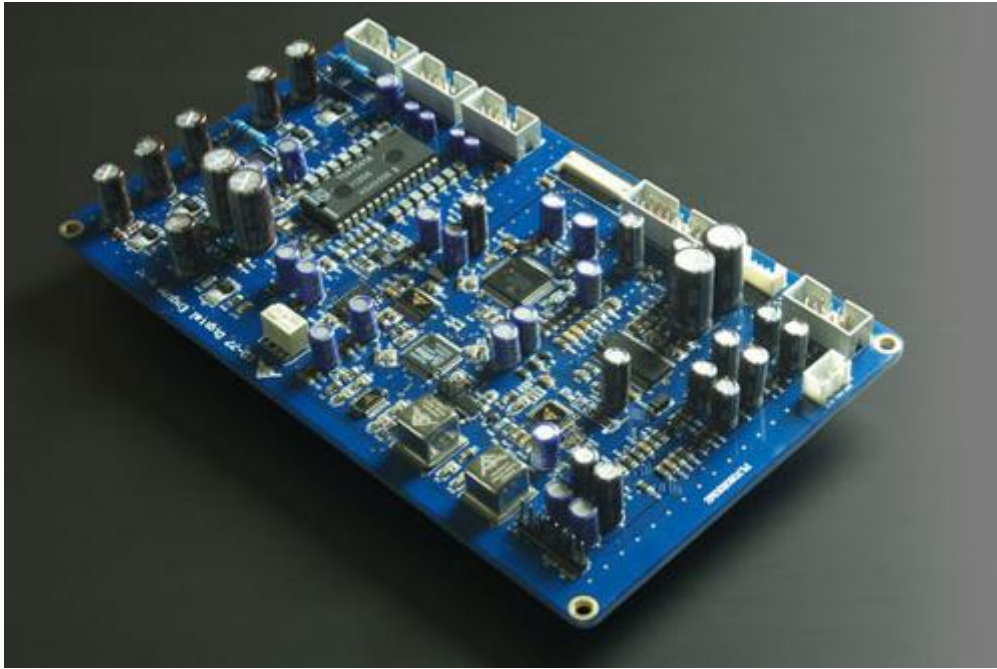
The result is the AMR High-Frequency Power Transformer which measures very nicely indeed.



## V. Panasonic OSCONs – if good enough for AMR...

For the iGalvanic3.0, we have pushed the sonic envelope just that 'little bit' further compared to the pre-production units that made the rounds.

At AMR starting from the CD-77 Compact Disk Processor in 2006, we have more than a decade of experience with components including the Panasonic Os-Con.

**Digital Engine from the AMR CD-77**

Trickling down from the AMR, the iGalvanic3.0 is the latest to receive a 'sprinkling' of Panasonic Os-Cons.

**The original and best. Sanyo/Panasonic Os-Con.**

Panasonic/Sanyo Os-Con (Organic Semi-Conductor) – are the original made by Sanyo (subsequently acquired by Panasonic in 2009) and are widely regarded as the ultimate capacitor for digital circuitry. We concur. Visibly, they have a distinctive purple marking and being the best (in our opinion) they are also the most expensive. Often costing many times the price of normal electrolytic capacitors, they are seldom found in +US\$5,000 products, never mind the iGalvanic3.0 at <US\$400.

**OS-CON**

Os-Cons have been around for a good while. Among the larger value capacitors useful in power supplies, they hold a special place. In a ground-breaking series on capacitor performance published in the late Nineties and early Noughties in Wireless World, Cyril

Bateman showed they persistently outperformed all alternatives at high frequencies and were second in low-distortion only to the Elna Silmic.

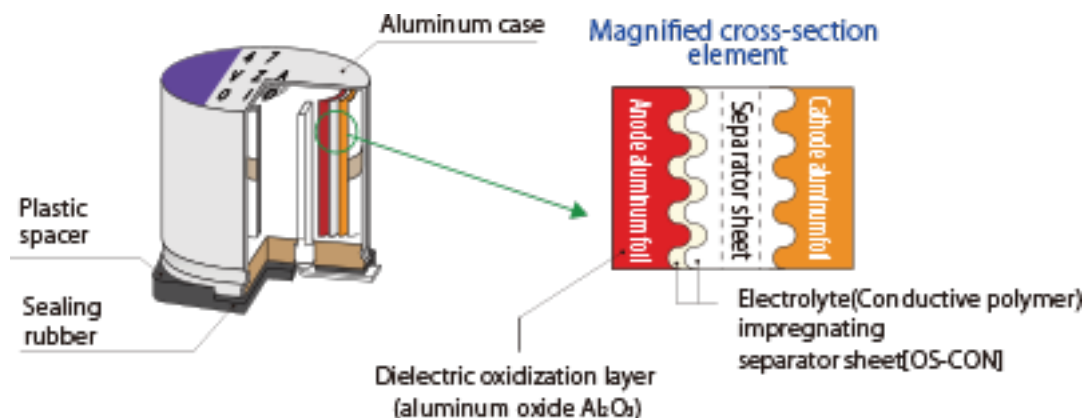
After the Panasonic takeover, supply chains were changed and they became difficult to obtain. Further, only more recently have Os-Cons become available in the small values/voltages/sizes needed for the relatively miniature equipment in the iFi range.

So despite their steep cost, (around 10x that of common electrolytic capacitors), the micro iDSD Black Label was the first to feature them.

**There are Os-Cons and there are Os-CONS.**

As a side note, a few years ago, when the 'Organic Semi-Conductor' patent expired, other manufacturers jumped on the 'Organic Semi-Conductor' bandwagon with their own attempts. We have tested these alternative 'Os-CONS' offered by other manufacturers. We were surprised to find they were little better than generic electrolytic capacitors and dramatically inferior to the original Sanyo product. It is reassuring to know that we have been tempted, but never switched and stayed true to Panasonic Os-Cons.

And here's how they look like both inside and out. Purple = good, whereas anything else = mediocre at best.

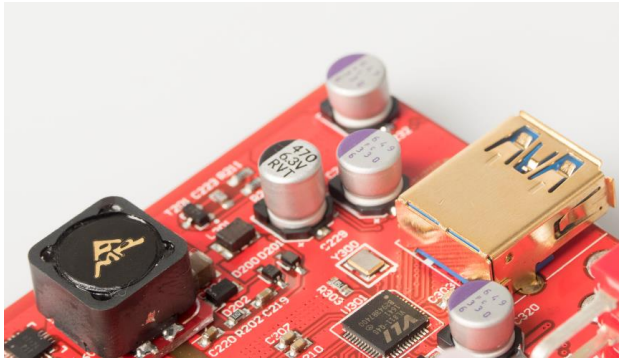


### A sprinkle of the purple magic

It is only logical that Panasonic/Sanyo with a 16-year start over their less costly imitations, is in our opinion *still* the best which is why the iGalvanic3.0 features the real Os-Con in certain areas:

2 x Power Supply for the downstream REgenerate<sup>2</sup>/REclock<sup>2</sup>/REbalance<sup>2</sup> section.

1 x for the Output Power supply.



## VI. Aircraft-grade aluminium for EMI/RFI shielding



The iGalvanic3.0 features the iFi trademark aluminum block. This enclosure acts as a shield against harmful electromagnetic interference (EMI/RFI) to further minimize noise. Blocking all the noise coming from a PC results in vast sound quality improvements. Non-aluminium designs offer little to no shielding from EMI/RFI.



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## Part 3 - How do the iGalvanic3.0 and iUSB3.0 fit together?

Most, who require the 'holy grail' of galvanic isolation, will use the iGalvanic3.0 stand-alone. Using the analogy of adding an external clock to a DAC, the micro iUSB3.0 compliments the iGalvanic3.0 in a similar vein.

Add the micro iUSB3.0 to the iGalvanic3.0 for those who wish for the last 5%-10% of sound improvement and additional enhancement options:

- 1) The absolute quietest power supply AND
- 2) Dual-headed outputs for audio + power transmission via Gemini USB cable AND
- 3) Dual-ports: for dedicated SSD/HDD and DAC transmission lines.

For the perfectionist with a reference class, money-no-object system with a +US\$10,000 DAC striving for the absolute zenith to add the drop of performance, we recommend to compliment with the micro iUSB3.0. Which adds additional benefits outside of the scope of the iGalvanic3.0 such as Dual-Ports and a noise floor of 0.1uV (0.0000001V).



### The iGalvanic3.0 doesn't really compare to others.

Other USB galvanic isolation devices are limited to Full Speed (12 Mbps) and Low Speed (1.5 Mbps) transmission.

By comparison the iGalvanic3.0 represents the next generation as it is capable of transmitting USB Hi-Speed (480 Mbps) and USB3.0 Super-speed (5Gbps) as well as the lower speeds while providing full galvanic isolation of both the data and the power/ground lines.

Where others have stopped at USB2.0 galvanic isolation, we started with USB3.0 galvanic isolation and absolutely turbocharged the device for the ultimate in USB audio:

- 1) REgenerate<sup>2</sup>/REclock<sup>2</sup>/REbalance<sup>2</sup> 'double stages
- 2) USB3.0 galvanic isolation and specified it for high-performance computer audio only
- 3) Power Station: Stealth Converter –ultra low-noise, regulated USB power throughout

## Summary

We hope you enjoyed reading through the technical notes on how the iGalvanic3.0 came to fruition. For any and every USB computer audio user, the sonic improvement is not subtle. With its dedicated USB3.0 isolation developed from the ground-up for computer audio and Grounding settings, it is ready to be perfectly dialed into any and every computer audio system with advancements that others just do not have.

It is not just an amalgamation of chips and capacitors from a parts catalogue. We really took our time and went to all the way with it. It really is the *holy grail* of USB audio.



For further information, please contact:  
Victoria Pickles  
[press@ifi-audio.com](mailto:press@ifi-audio.com) / +44 (0)1704 227 204



### About iFi

iFi audio is headquartered in Southport, UK. It is the sister brand of Abbingdon Music Research (AMR). They respectively design and manufacture portable and desktop 'ultra-fidelity' audio products and high-end audio 'home-based' components. The combined in-house hardware and software development team enables iFi audio and AMR to bring to market advanced audio products often ahead of the competition, with several 'world firsts' in their portfolio.