Active DI Box ADIB Mk2b

User manual

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An Active Direct Box featuring the best of active and passive designs with none of their short comings

- Genuine earth isolation
- Class A FET input amplifier
- Low noise and distortion
- Buffered and direct outputs
- No pad switch
- Transformer balanced output

What's in a D.I. Box?

D.I. Boxes are constructed using one of two common techniques.
• The first type uses electronic circuitry and are known as active D.I. Boxes. They require either Phantom Power or a battery supply.
• The second variety uses an audio transformer and are known as either transformer or passive D.I. Boxes. They require no power supply.

A D.I. box is required to perform three separate basic tasks.
1. Impedance Conversion
2. Unbalanced to balanced conversion
3. Earth isolation

1. Impedance Conversion
The medium or high impedance of a signal source is converted to a low impedance suitable for feeding down a long multicore to a mixing desk's microphone input. A low impedance enables long cable runs, with very little quality loss, and also low susceptibility to external electrical interference which can cause hum and buzzes. A D.I. box should provide a high input impedance for connection to a signal source, and a low output impedance for connection to the microphone input of a mixing desk. The input impedance of many D.I. boxes is too low, resulting in either the highs or lows being attenuated.
The very high input impedance of The Leon Audio Active D.I. Box preserves the full frequency response of the original signal.

2. Unbalanced to balanced conversion
The unbalanced (2 conductor) wiring of a signal source is converted to the balanced (3 conductor) wiring of a mixing desk's microphone input. A balanced cable provides good rejection of electrical interference, while an unbalanced cable does not. Active D.I. Boxes are potentially capable of providing excellent unbalanced to balanced conversion, but due to cost restrictions, most are poor performers in this area.
The Leon Audio Active D.I. Box uses a quality transformer to provide excellent unbalanced to balanced conversion.

3. Earth isolation
A D.I. Box provides isolation between the earth wiring of a signal source (e.g. musical instrument) and the sound system to which it is being connected. This prevents earth loops from occurring. An earth loop occurs when a device such as a keyboard is connected to the mains earth via more than one path. The first path is via the instrument's own power cable to the mains earth. The second path is via the interconnecting audio cable to the sound system, then via the sound system's power cable to the main's earth. Any resultant circulating earth current is amplified and is heard as a hum or buzz. These unwanted earth currents are usually induced from nearby power and lighting cables. Active D.I. Boxes are usually very poor at providing good earth isolation, because there is usually a direct electrical path between the instrument and the sound system, even if its earth lift switch is lifted.
The Leon Audio Active D.I. Box uses a quality transformer to provide excellent earth isolation.

Earth Lift Switches
D.I. boxes have an earth lift switch to allow the earth connection between its input and output connectors to be broken to prevent earth loops. Disconnecting the signal (audio) earth is not a safety issue, as the Protective Earths in all the mains cables are still connected and fully functional.

Pad Switches
Pad switches are often provided to allow D.I. boxes to handle higher level signals which would otherwise overload the D.I.'s electronics.

Description

The Active Direct Inject (D.I.) Box is designed for optimum performance with any musical instrument signal source, especially in electrically hostile environments such as live performance venues using light dimmers.

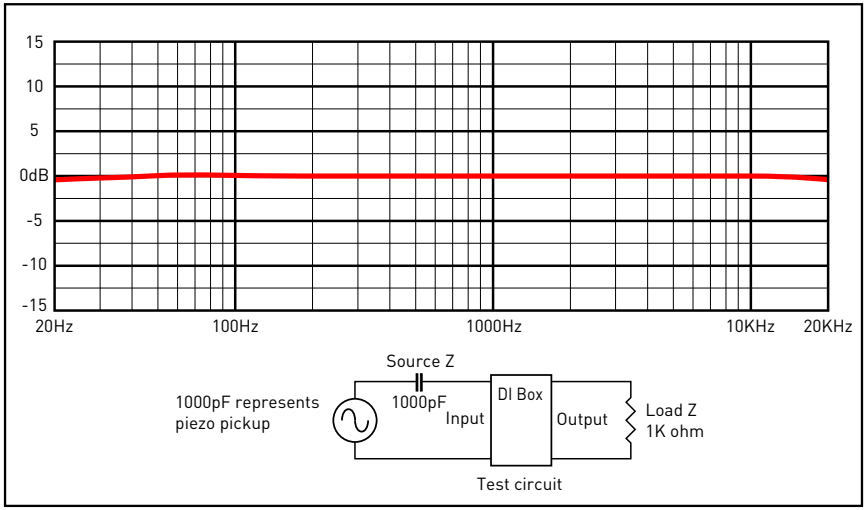
The input is buffered by a class 'A' FET (Field Effect Transistor) amplifier which has a 33 Meg ohm (33 million ohms) input impedance . The XLR output is isolated via a custom made high performance audio transformer.
There are two unbalanced outputs for connection to a musician's stage amplifier. The first is connected directly in parallel with the input. The second provides a buffered output to prevent the musician's stage amplifier from over loading the instrument's pickup and degrading performance.

The active FET input stage provides the benefits of low noise, low distortion and high input impedance, while the heavily screened output transformer provides very high isolation between the input and XLR sides of the D.I. Box. The transformer provides maximum immunity to external electrical interference and also reduces earth noise to an absolute minimum.

The D.I. is designed to operate without compromise when the earth lift switch is lifted. Many other active D.I. boxes will not operate correctly, or at all, when the earth switch is lifted as there is no return path for the Phantom Power.
A DC/DC converter is used to power the active input stage via it's own isolation transformer. This allows genuine earth isolation at all times.

The ability to handle high level inputs up to +15dBu means that a pad switch is not needed.

The D.I.'s high input impedance minimises loading of the signal source. This results in minimal loss of bass or treble when used with instruments with high source impedances. Piezo pickups are one example of high source impedances.
A high input impedance is also suitable for connection to low output impedances such as keyboards or mixers. Impedance matching is not required, nor is it even desirable, as we want to achieve the maximum possible signal transfer, not the maximum possible power transfer that a matched impedance offers. Matched impedances are generally undesirable and not normally used in audio systems.



Active D.I. Box frequency response when fed from a piezo source.

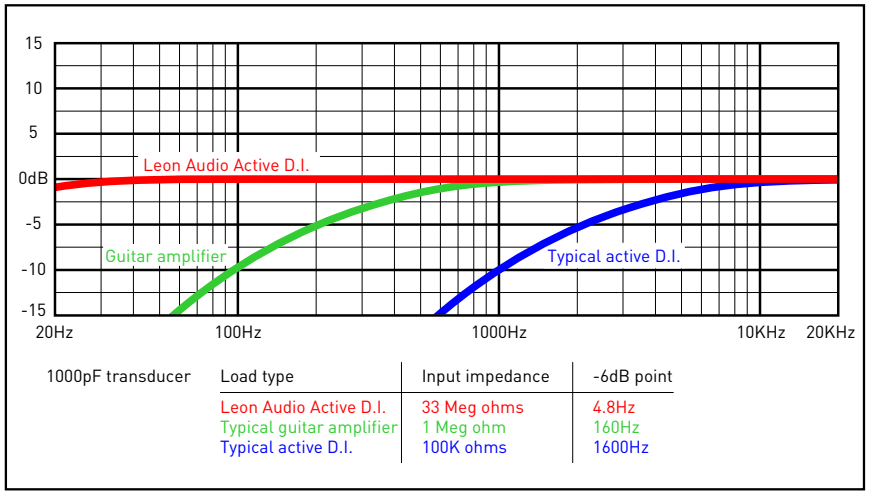
Piezo Pickups

Q: Why do many Piezo Pickups sound thin and bright?
A: Because the bass is heavily attenuated.

The capacitive characteristic of piezo pickups results in their output level decreasing as frequency decreases when connected to a typical instrument amplifier which has an input impedance of about 1 Megohm (1 Million ohms). This loss of low frequencies is due to excessive loading of the pickup by the amplifier which was never designed to work with piezo pickups. An extremely high load impedance, typically greater than 20 Megohms, is needed to provide negligible loss of bass frequencies. The above situation is further compounded by connecting the piezo pickup to a D.I. box. The total load seen by the pickup is now that of the DI box and the instrument amplifier in parallel.

The input impedance of a typical D.I. is 100K-200K ohms, which results in a very heavy load on the piezo pickup and consequentially a heavy loss of low frequencies.

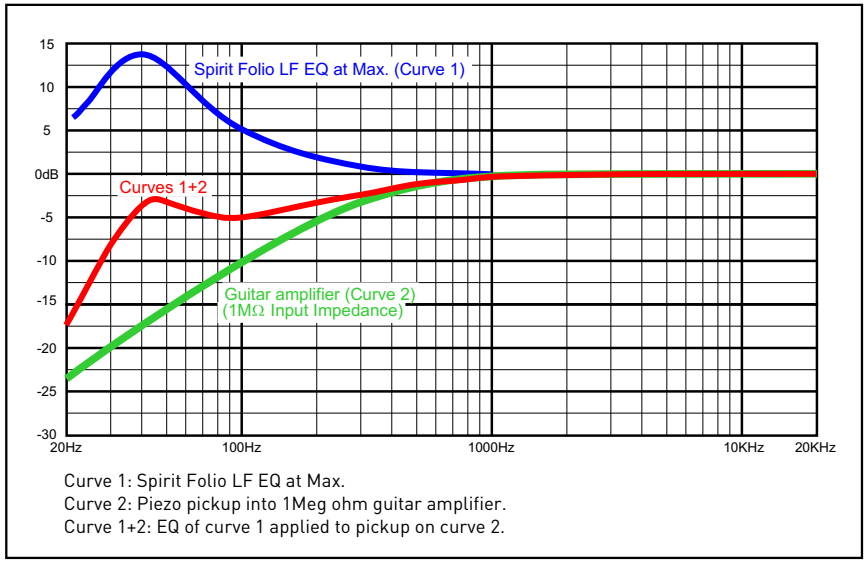
The solution is to use a D.I. box which provides an extremely high input impedance and a buffered output to drive to the instrument amplifier. With this arrangement, the piezo pickup is only loaded by the input impedance of the D.I. box, resulting in a flat and wide frequency response
The Leon Audio Active DI box is one such solution.



1000pF transducer	Load type	Input impedance	-6dB point
	Leon Audio Active D.I.	33 Meg ohms	4.8Hz
	Typical guitar amplifier	1 Meg ohm	160Hz
	Typical active D.I.	100K ohms	1600Hz

Piezo pickup frequency response Vs various load impedances

Attempts to recover the lost bass of an overloaded Piezo pickup using conventional tone controls is usually less than successful. The problem is that the bass rolls off at the rate of 6dB per octave, and conventional tone controls can not create an inverse of this roll off.
Curve #1 is a typical bass tone control set at full boost.
Curve #2 in the graph below shows the response of a Piezo pickup rolling off at 6dB per octave.
The centre curve in red shows the bass boost applied to the signal lacking in bass. The result is still lacking in bass but more importantly, it is far from flat. It is much better to cure the disease than to treat the symptoms.
Using a DI box with a very high input impedance to prevent the loss of bass in the first place, is much better than trying to patch it up later.



Curve 1: Spirit Folio LF EQ at Max.
Curve 2: Piezo pickup into 1Meg ohm guitar amplifier.
Curve 1+2: EQ of curve 1 applied to pickup on curve 2.

Low frequency roll off showing poor bass response even with +15dB of EQ

Two Output Jacks

A typical D.I. configuration has an instrument plugged into the input of the D.I., and a mixing desk into the XLR output. A stage amplifier can be connected to either the direct or buffered output jacks. If the stage amplifier is connected to the Buffered output jack, the instrument will only see the 30 Megohm input impedance of the D.I. box. This results in the best possible frequency response when using high impedance pickups such as piezos. An extra octave of low end, or part thereof, can be obtained, compared to a regular D.I. Box. This may cause problems for the musician as his stage sound will be different. If this increased low end is unacceptable, connect the stage amplifier to the Direct output jack. The instrument will now be loaded by the input of the stage amplifier. Depending on the type of pickup used, large amounts of bass roll-off may occur. The Direct output jack was provided so that the musician can retain their normal but degraded sound that they are used to. Connect the stage amplifier to the Buffered output whenever possible.

Power Source

Power for the FET input amplifier needs to be returned to the XLR connector. This can not be achieved when the Earth Lift switch is open. There are 4 possible options ...

1: Use batteries. This option was considered unacceptable in a professional D.I. box

2: Do what other active D.I. boxes do and allow the Phantom Power to return via the instrument's mains earth connection. A great way to pick up lots of electrical noise.

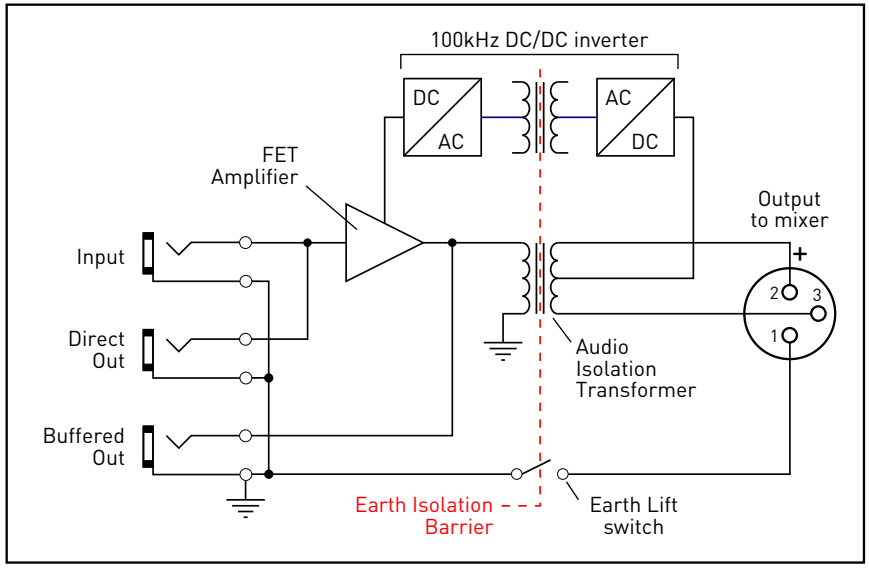
3: Do what other active D.I. boxes do and use a partial Earth Lift. This concept works well in the showroom. It fails in the real world when electrically noisy environments are encountered.

4: Use a complex isolated DC/DCinverter for the FET input amplifier.

Option 4 was chosen as it is the only one that offers genuine earth isolation between the input and the XLR output of the DI Box.

The drawing below shows that there is no direct electrical connection across the Earth Isolation Barrier.

A DC/DC inverter is used to get the FET amplifier's power across Earth Isolation Barrier. Phantom Power is first extracted from the centre tap on the bifilar wound secondary of the audio transformer. This drives a DC/AC converter running at 100kHz which in turn drives a small power transformer. The resultant 100kHz AC voltage on the secondary of the power transformer is rectified and filtered to provide 18 volts DC to run the FET amplifier. As a result, there is no interruption to the FET's power supply when the Earth Lift switch is operated. As the FET amplifier is operating on an 18 volt supply, it is able to handle much higher signal levels than if it were operating from a 9 volt supply, such as a battery. This means that the DI Box can handle input signals up to +15dBu without the need for an input Pad switch. (0dBu = 0.775Volts)



Block diagram of the Active D.I. Box

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Specifications

0dBu = 0.775 volts

Input Level
+15dBu Maximum.

Input Impedance
33,000,000 ohms unbalanced

Outputs
1: Direct out. In parallel with the input
2: Buffered out
3: XLR Out. Transformer balanced with earth lift switch

Output Level
Buffered Output: 0Bu when driven with 0dBu input
XLR Output: -15dBu when driven with 0dBu input

Output Impedance
Buffered Output: nominal 5,000 ohms
XLR Output: nominal 75 ohms

Recommended Load Impedance
Buffered Output: 50,000 ohms or greater
XLR Output: 600 ohms or greater

Connectors
Input: 6.5mm (1/4") nylon jack socket
Direct & Buffered Outputs: 6.5mm (1/4") nylon jack socket
XLR Output: Genuine Neutrik 3 pin male XLR

Frequency Response

10K ohm source, 1K ohm load	20Hz - 20kHz ±0.15dB
1,000 pF source, 1K ohm load	20Hz - 20kHz ±0.45dB

Power Supply
48V Phantom Power with indicating LED

Supply Current
4.2mA at 48 volts

Dimensions.
W 95mm H 120mm D 67mm

Finish
Powder coated die cast aluminium

Weight
520 grams net
620 grams gross

Warranty
The Leon Audio Active DI Box is guaranteed for two years from date of original purchase against defects in workmanship and materials. If such malfunction occurs, the item will be repaired or replaced (at our option) without charge for materials or labour if delivered prepaid to THE LEON AUDIO COMPANY. Unit will be returned prepaid. Warranty does not cover finish or malfunction due to abuse or operation at other than specified conditions. Repairs by other than THE LEON AUDIO COMPANY or authorized agents will void this guarantee.

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