Selecting the right direct box for bass, keyboard and acoustic guitar

Few artists or engineers ever consider the task of choosing a direct box. In fact, for the most part, they simply plug their axe into one of these non-descript devices and assume their sound will magically appear at the PA or recording system without artifact. What they do not realize is that inside these 'magic boxes' are passive isolating transformers or active buffering amplifiers that are the motors that do the work.

A direct box is, in essence, a device that enables an instrument such as a bass guitar or laptop computer to connect to a distant PA or recording system. These high impedance, unbalanced sources are limited to cable lengths up to 8 meters (25') before noise creeps in and in the case of passive sources such as an old Fender® Jazz bass, the load from 100 meters of cable can seriously affect the tone of the instrument. The direct box is used to balance the signal to gain immunity from external magnetic fields and lower the impedance to allow long cable distances upwards of 100 meters (328') without loss.

Written By: **Peter Janis**

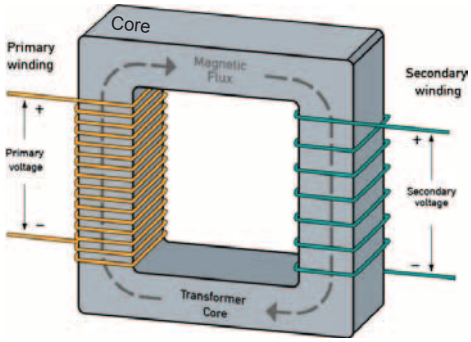
President of Radial Engineering, Peter Janis, has been crafting studio and tour ready products since 1991. Artists around the globe rely on Radial to keep their tone pure in the studio and on tour. Here are some tips Peter Janis offers to help you choose the right direct box for you!

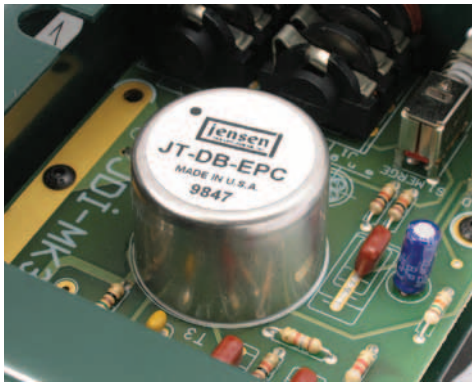
Passive DIs

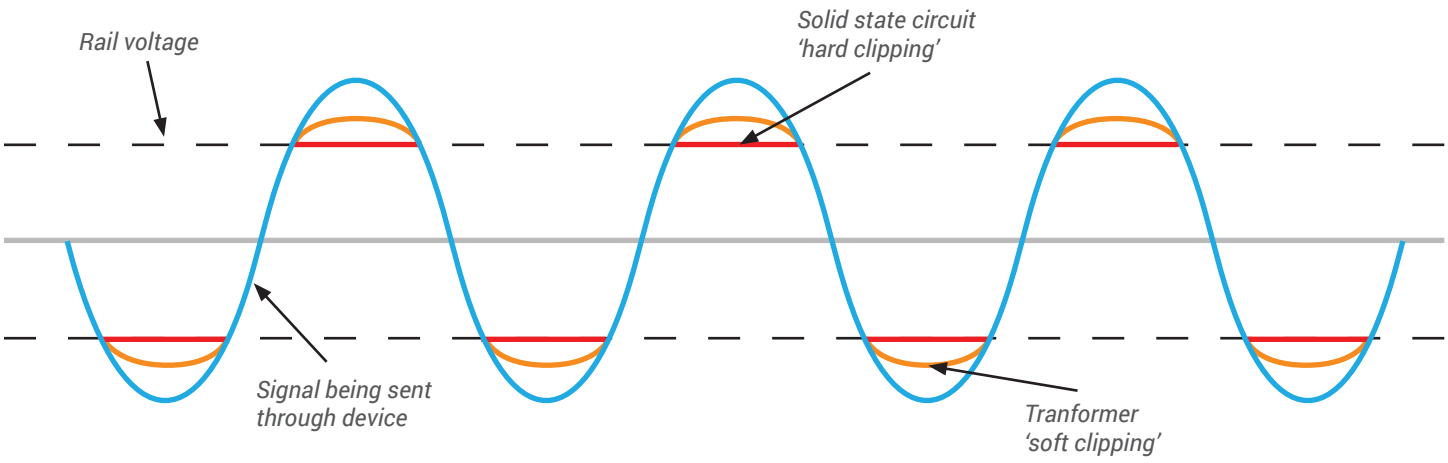
There are two categories of direct boxes: passive and active. The engine inside a passive direct box is a specially designed transformer that performs both the balancing and impedance conversion. Passive DIs like their dynamic microphone counterparts, do not require power. And like a dynamic mic, a high quality passive DI box like a Radial JDI™ can be 'hit hard' yet sound great. Think of an SM57 on a snare.

A transformer is essentially a magnetic bridge with an input (primary coil) and an output (secondary). In between, a series of laminations make up the core. Top end transformers, such as those made by Jensen, employ nickel laminations and proprietary winding techniques to reduce distortion and group delay. Unlike solid state circuits that go from almost 0% distortion to 100% distortion when pushed beyond their intended limits (the rail voltage), transformers 'gradually' saturate. With a high quality transformer, this manifests itself in the form of a pleasing even-order distortion or natural compression that is often referred to as 'vintage sounding'. There is good reason for this, most vintage audio equipment employed transformers in both their input and output stages. High quality transformers are extremely difficult to manufacture and are expensive. This is why most audio equipment manufacturers no longer employ transformers in their designs.

Unlike solid state circuits, transformers 'gradually' saturate when pushed hard.







Due to the signal handling capacity and 'warm tone' of passive DIs, they are often preferred on dynamic sources such as high output active basses and digital pianos. These instruments will often overload their active DI counterparts. Transformers are unique in that they allow AC (alternating current) to pass while they block DC (direct current). One of the most challenging problems in audio is getting rid of 50 or 60 cycle hum commonly known as ground loops. Ground loops are caused by a number of things including differing ground reference voltages between the connected devices causing havoc, less than ideal electrical wiring, and stray DC voltages traveling along the audio signal path. Because the transformer inside is in fact a magnetic bridge, the input and the output are not electrically bonded – the input source and output destination are isolated. With a passive direct box, once the audio ground is lifted, noise problems are usually eliminated.

Because passive DIs do not have any power, the signal 'drive' comes from the instrument's pickup or internal amplifier. Although top end passive DIs have an input impedance of around 140,000 Ohms, loading from the transformer and cable on the pickup can affect the tone. So when using a passive source like a low output P-bass, an active DI is often preferred.

JDI™

Best Performance

The Radial JDI is a passive direct box designed to handle extreme signal levels without distortion of any kind.

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ProDI™

High Performance

The Radial ProDI is a passive direct box that combines exceptional audio performance with solid dependable construction, making it the ideal general duty direct box for stage and studio.

» More Info

SB-2™

Best Value

The Radial Stage Bug SB-2 Passive is a high-performance direct box made for players who are on the move!

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Active DIs

Active direct boxes are essentially unity gain amplifiers that employ an electronic circuit to perform the impedance conversion and balancing. Like a condenser microphone, active DIs require power, either in the form of a battery, power supply or via phantom power. Active DIs gained popularity due to the universal availability of 48V phantom power and their lower cost to produce compared to using a high-end transformer. Like a condenser microphone, active direct boxes tend to have more 'reach' versus their passive counterparts and, because a 'buffering amplifier' is driving the signal, the input impedance can be elevated to the point where the added load of the direct box and cable will have little or no effect on the instrument. This explains why they are often preferred on passive instruments such as an old Fender P bass or acoustic guitars.

Just like a mic preamp or power amplifier, the price and quality can vary significantly. Solid state circuits are limited by the rail or supply voltage. When the incoming signal surpasses the working limits the signal is clipped and harsh sounding 'square wave' distortion is produced. Phantom power was originally developed as a means to charge the capacitive plates of a microphone. The relatively high voltage (48V) with low current (5 to 10 milliamps) works well for this application. But for an amplifier (active direct box), the limited current makes it challenging to achieve enough headroom to handle todays' flurry of active instruments. Recent designs such as the Radial J48 and J48 Stereo have improved headroom by incorporating switching supplies into the power system. This eliminates the need for pre-padding the input to avoid distortion and results in a higher output level and less noise.

The other benefit that the J48 brings to the table is the ability to lift the ground without disconnecting phantom power. In the past, lifting the ground meant switching from 48V phantom to relying on an internal 9V battery. And as any professional will tell you, batteries always go dead in the most inopportune times, and as the power output lowers, distortion multiplies. By lifting the ground inside the power supply, you can eliminate ground loops without resorting to batteries.

Active DIs tend to have more 'reach' versus passive DIs due to a 'buffering amplifier'

J48™ Stereo

The Radial J48 Stereo is a high performance active direct box designed for professional touring and studio recording. It features the same award-winning signal path that has made the single channel J48 the most specified active direct box on tour today. And with users as diverse as Paul McCartney, Tommy Emmanuel and Joe Chiccarelli, you can be sure it will meet the most demanding qualifications.

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Which is better?

This same question applies to microphones: which is better, a dynamic mic or a condenser? The answer is: it depends. As a rule, high level output sources such as synthesizers, digital pianos and active basses are better suited to passive direct boxes. A high performance passive DI like the JDI™ Stereo not only handles these high output instruments with grace, but when pushed hard, the Jensen transformers smooth out the transient response.

For low level signals such as a passive bass, magnetic acoustic guitar pickup or a vintage Rhodes piano, an active direct box like the Radial J48™ is a better choice. The active circuit will easily handle transients that can be as high as 9 volts without choking. Because of the active circuit and higher 220,000 Ohm input impedance, the active DI will not load down the pickup, thus resulting in a more solid sound on stage.

So why do artists like Paul McCartney, Neil Young and Tommy Emmanuel use a J48 on their active acoustic guitars? Because they like the sound. Personal choice always plays a major role in why we do things and with DI boxes it is no different. The passive JDI and active J48 both have ruler flat response curves that span for 10Hz to well above 40kHz. They are both able to handle tremendous signal levels without distortion and are truly faithful to the sound of the instrument.

Marcus Miller

"When I forgot to bring my Radial JDV™ to a session, my engineer made me go back home to get it! That's how good it is."

Miles Davis, Herbie Hancock, Micheal Jackson, Elton John, Wayne Shorter, Luther Vandross, David Sanborn

Tommy Emmanuel

"I love my Radial J48 direct boxes! They produce a big, fat and clean signal that is so good; they are the ones I use for my live recordings. Thank you Radial!"

Grammy-nominated 'Certified guitar Player'

Chick Corea

"Radial direct boxes make everything I put through them warm, punchy and clear. They are great DI's!"

Electrik Band, Miles Davis, Return to Forever

Next Time!

HOW TO DEAL WITH EXTREMES

Using piezo transducers and guitar amplifiers