

# RADIAL DIRECT BOX

## J48 Phantom Powered

### OWNER - OPERATORS MANUAL

Rev 2.0 - February 27, 2002

#### ***Congratulations on your purchase of the Radial J48™ direct box.***

Three years in the making, the J48™ has been optimized to provide exceptional dynamic range while only using the limited current from typical 48-Volt phantom power. This is achieved by creating a high internal power rail voltage to handle the excessive output of today's powerful battery-powered active basses and acoustic guitars. This allows the console to receive the full dynamic output of the instrument without square wave distortion or choking due to signal overload.

The secret is the J48's internal 'power house' that converts the minute current produced by phantom to a higher rail voltage. The J48 is able to manage bursts as high as 10 peak volts. In fact, every aspect of the J48™ design has been optimized for maximum headroom while introducing minimal phase deviation, harmonic distortion and inter-modulation distortion. This ensures that whatever sound you put in, you get out. Nothing altered, nothing changed, just the pure and natural tone of the instrument.

We invite you to read through this manual before using the Radial J48™ so that you can maximize its potential. Please log on to [www.radialeng.com](http://www.radialeng.com) for further details and updates. We invite you to forward any comments, questions or suggestions about our products or ideas for new products you would like to see us develop.

We would love to hear from you!

Enjoy.

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### ***Part 1 Introduction - Quick start***

The Radial J48™ is an active direct box. This means that it requires power from a source such as a battery or from the console's phantom power supply. For more information about 48 volt phantom power, go to the FAQ section at the end of this manual. As most equipment today comes standard with phantom power, the J48™ comes set to be used with 48V phantom power. It may be adapted to also be used with one or two 9 volt batteries should the need arise. See the section: 'Using the J48 with batteries' for more details on this.

To start, make sure the volume is off on the sound system and your amplifier. All switches should be set in the 'out' position. Plug the instrument into the input, the thru-put to your instrument amp, and the XLR out to the mixer. Make sure the phantom power on the mixer is turned on. Check for power by depressing the 80Hz filter switch on the J48's output panel while eying the LED on the input panel. The LED will momentarily illuminate to let you know it is receiving power. As the LED consumes almost as much energy as the J48's pre-amp circuit, it is kept off in order to ensure maximum energy resources are directed to the audio signal path.

If the LED momentarily lit-up, you should be ready to go! Turn your mixer up to the desired level and enjoy! If you encounter hum or buzz, try lifting the ground as this often helps eliminate ground loops that can appear between your mixer and your amplifier. The 80Hz filter is a smooth roll-off that will help eliminate rumble with bass guitars and low frequency resonance on acoustics. For fun, try reversing the 180° polarity switch.

The J48™ will allow the natural sound of the instrument to shine through without coloration, distortion or noise. Now go out there and make some music!

### ***Part 2 - Some DI Basics***

***What is a direct box?*** The name 'direct box' comes from direct insert box. This is why these marvelous contraptions are also called DI's. 'Direct Insertion' means exactly that: *To insert a signal directly or take an audio signal from the source and send it **directly** to a mix point or recorder.* We take this very seriously with all our direct boxes and as such, have designed these to reproduce the most accurate 'picture' of the source no matter the instrument.

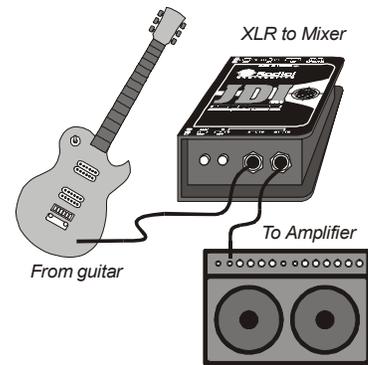
Direct boxes perform several important functions (balancing, isolation) although they are primarily designed as impedance matching devices. This means that they take the high impedance of a guitar or keyboard and 'transform' it to the low impedance used in balanced sound systems. By properly matching the impedance you will enjoy better sound, less noise and an extended frequency response.

### Plugging it in

All direct boxes follow the same basic procedures in connecting them in a system. The instrument plugs into the 'IN' while the mixer or recorder is connected from the XLR 'OUTPUT'.

A 'THRU' connection is provided that allows the instrument to be connected to the performer's amplifier. This allows the mixing engineer to 'tap' the signal **before** it is modified by the musician, thus resulting in the purest source possible. It is important to note that what may sound good on stage may not necessarily sound good in the venue. By sending an unaltered signal to the front of house mix position (FOH), the engineer is able to get the sound he is looking for with minimal phase and harmonic distortion.

This is probably the main reason why Radial direct boxes are so popular. Radial DI's do not alter the sound in any way before it gets to the mix position.



## Part 3 – The Features

### 1/4" Input jacks

The J48™ features two 1/4" jacks on the input panel. The left primary input is normally connected from the source instrument. The second right-hand 1/4" connector is normally used as a 'thru' connector to direct the original signal to the instrument amplifier.

### High input impedance

The J48™ presents the instrument with a very high input impedance to minimize pick-up loading. This means that low output instruments such as old Jazz or P-basses will not sound different when connected to the instrument amplifier. Note that the pick-ups are now feeding both the instrument amp and the direct box signal simultaneously. The J48's high input impedance only taps a minute amount of signal and then sends this signal through a pre-amp which then sends out a balanced signal to the mix position. A lower input impedance can reduce the signal level and alter the tone. For the most part, with today's high output instruments, loading is not so much an issue. The concern is distortion...

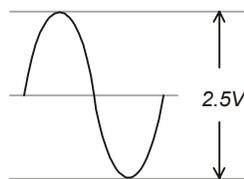
### Input Distortion

A major concern today is input distortion and dynamic headroom. Just about every acoustic guitar (and many basses) incorporates built-in active pre-amplifiers that boost the pick-up's output signal. Further, the musician turns the volume up and pushes his active EQ beyond the nominal (0dB) level. Since these high gain pre-amps often generate as much as 9volts, the high output signal saturates the input of most active direct boxes causing harsh square wave distortion. Even though the console may provide 48V phantom power, there is so little current available that most direct-boxes are unable to produce enough peak-to-peak rail voltage to handle the signal. This is why acoustic guitars often sound 'thin' and 'abrupt' or 'peaky' during a live performance and is all the more distressing with bass guitars and keyboards that have tremendous energy in the low end (bass frequencies). Once the signal is distorted, you cannot limit or EQ it out. This is not good.

The J48™ is designed to handle these signal levels without fear of overloading and is one of the main advantages you will enjoy with your J48™. The J48™'s response ranges from 10Hz in the low end and will extend to 40kHz at the extreme highs. Because we have created an internal 'power house' by driving a custom-made switching transformer, one can hit the J48™ with as much as 10 volts and it will not choke. Thus you get a clean and natural sound even when subjecting the J48™ to high levels and extreme dynamics.

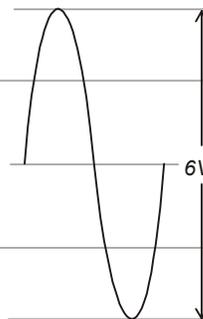
### Passive Bass Guitar

Notice older basses have a very low peak to peak voltage.



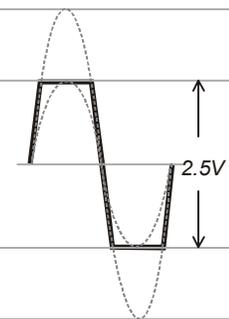
### Active Bass Guitar

Notice more than double the voltage than passives



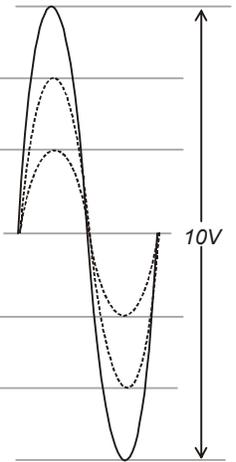
### Other DI box designs

These were developed for use with passives



The result is square wave distortion

### Radial J48 headroom



Occasionally, you may encounter some devices with extremely powerful levels than can overdrive the circuit. Although this is rare under normal instrument use, a provisional 15dB pad steps down the input to ensure a clean and distortion-free signal is obtained. A typical case may be the headphone output signal from a Walkman.

### **The Merge switch**

The merge is a 2-in, 1-out resistive mixer. This innovative and unique function allows two sources such as a stereo bass or a stereo keyboard to merge to mono at the XLR output. The merge function is primarily used in live sound whereby mono or point source set-up and mixing is typical. The merge function saves valuable channels on the snake and on the mixer. To 'merge' simply connect two instruments with similar output levels into the IN and THRU jacks, place the MERGE to the ON position and you are set to go.

### **The Balanced XLR Output**

The J48™ features a balanced output jack that uses a standard XLR connector. This jack is wired to the AES (Audio Engineering Society) standard with pin-1 ground, pin-2 hot and pin-3 cold. Today, pretty much all equipment is manufactured using this standard. Connection is made to the mic-level input of the mixing console or to a standard mic pre-amplifier. The J48™ is ideally suited for interface with concert snake systems and splitters where mic and direct box signals are directed to several destinations at the same time such as recording, monitor, broadcast and front-of-house mix positions.

### **The Polarity Reverse switch**

A polarity reverse is provided that toggles pin-2 and pin-3 as the 'hot' or positive signal. This provides several operational benefits: Interfacing with older mixing consoles that have pin-3 hot is simply a matter of depressing the polarity reverse. When simultaneously mic'ing your amp, and using a 'direct signal' from the same instrument, one may encounter 'phase' problems. Reversing one of the source polarities sometimes alleviates this. This same process, while recording, provides the engineer with an alternative 'tonal palette' that can provide pleasing results. Although normally one should keep the polarity 'in-phase', experimenting with different settings can lead to some very pleasing results. *For more information on the differences between 'polarity-reverse' and 'out of phase', please go to the FAQ section at the back of this manual.*

### **The Ground Lift switch**

The Radial J48™ has a ground lift switch to disconnect the input ground from the system. Sometimes, when using devices that are AC powered such as keyboards or amplifiers one will encounter 60 cycle hum or ground noise. Trying the ground-lift may sometimes help. *Note: the ground is lifted at the input as the XLR output requires the ground to provide phantom power.*

### **The 80Hz rumble filter**

As with all audio, bass or low frequency signals contain anywhere from 10 to 20 times the energy as high frequencies to achieve the same perceived loudness. A good analogy is the power used in a PA system: The low frequency drivers always need way more power than the highs. This is why it is so important to check equipment specifications at the low end. Anyone can make 1kHz look good on paper. But for the real deal, if your direct box can handle 20Hz without a whimper, you are dealing with a serious piece of gear! This means that if you do not have to amplify low frequencies, the system will not have to work as hard resulting in less overall distortion and a better sounding mix.

The Radial J48™ is equipped with a low frequency roll-off filter that starts at 125Hz and gently rolls off the low end to where it drops down 3dB at 80Hz. This conserves energy and reduces low-frequency rumble from the bass and resonance from the hollow acoustic guitar body.

## **Part 4 – The Mechanics**

### **Built like a tank!**

One common feature you will find on all Radial products is our relentless pursuit of durability. Open up the Radial J48™ and look inside. You will note the J48™ is made of two steel boxes in one. A heavy-duty welded 14-gauge internal skeleton houses the PC board, circuit and connectors. The PC board is two-sided which means that all components are soldered twice. Further, it is impossible to torque the PC board once installed. This ensures years of performance without failure.

An innovative 'book-end' construction features 'front and back' recessed panels that protect the switches and connectors from being damaged during transport or from over-zealous roadies. Five minutes before a show is no time for a switch to be broken. Worse yet, testing and sorting out noise and ground problems and doing sound checks can sometimes take hours. This can easily be hampered by a simple throw of a switch. ***You'll be glad our switches are tough to switch!***

The finish is a baked epoxy that should provide years of performance and still look great! The J48™ is also outfitted with a full bottom no-slip pad that also acts as a shock absorber. The no-slip pad is ideally suited for stacking DI's or resting it on slippery surfaces. If the pad wears down, these can be ordered from the factory.

## **Part 5 - Using the J48™**

**Caution!** *When connecting any audio device always ensure the power is off or all gains are set to zero. This practice will reduce opportunity for any noise such as a capacitor discharge from being sent through the amplifier to the speakers, which could cause a speaker to blow.*

Plug the instrument into the INPUT. Connect the THRU to your amplifier and the XLR OUTPUT to the mixer. Set the PAD to 0dB. Depress the 80Hz filter switch to check for phantom power. If the LED next to the pad and merge switch momentarily illuminates, you are set. If not, check to make sure the console or pre-amp has the phantom power turned on. Turn up the input level at the mixer and check to make sure the J48™ is not overloading the input. If so, simply depress the -15dB PAD. If you encounter noise or buzz, try lifting the ground.

### **MERGE FUNCTION – Stereo to mono mix**

Set the MERGE 'off' unless you plan to use the input & thru as two inputs. If you have a stereo keyboard and would like to mix both channels through the J48™, connect them to the INPUT and THRU-put and set the MERGE switch to 'ON'. This feature can save valuable channels on your snake and your console!

### **The XLR Output**

The J48™ output is mic level and is connected to a mic input. This allows the J48™ to be used in the same fashion as a microphone on stage. Make sure the mixer's phantom power is 'ON' and you are set. Plug in and play.

### **Using the J48™ with batteries**

The Radial J48™ comes set to be used with 48V phantom power, as all mixers, pre-amplifiers and most mixer-amplifiers are equipped with phantom power. Should you encounter a situation where phantom power is not available such as when interfacing with vintage equipment, the J48™ may be outfitted with one or two standard 9volt batteries.

The conversion may be custom ordered from the factory at a nominal charge or may be field-installed by a competent technician. Contact Radial Engineering for the "Radial J48 Battery Installation Note" should you wish to do this installation yourself. **Please note that as Radial Engineering cannot control battery option installation, any damage due to improper soldering or damage to components is not covered under warranty.**

## **Part 6 - FAQ's or Frequently Asked Questions**

### **What is the difference between Active & Passive?**

This is somewhat similar to comparing dynamic mics to condensers. Active DI's have a built-in pre-amp that requires power to run while passive DI's use a transformer to convert the signal. Both 'transform' or convert the instrument's high-impedance output to a low impedance balanced microphone level. This allows long cable runs without adding unwanted noise and will improve the instrument's sound quality. The J48 uses phantom power to derive its power source.

### **What is phantom power and will it harm my other equipment ?**

Phantom power is a DC supply that comes from the mixing console on pins 1 and 2 of the XLR connector. It was originally designed to provide power to condenser microphones. It is usually 48 volts and about 5mA. All equipment used in pro-audio is designed to interface when phantom is on. As such, phantom will not harm your equipment.

### **Why do people use active direct boxes?**

Active direct boxes tend to have more 'reach' in that they can capture harmonics and dynamics that can be lost with cheap passive direct boxes with steel core transformers. They are also less prone to loading the instrument, which can change the instrument's tone.

### **Can you explain loading?**

Years ago, most bass guitars used regular output pick-ups such as those found on Fender basses. Musicians found that connecting the bass 'thru' a direct box and then to their amplifier caused the sound to change. This was caused by the added load of the direct box driving the signal to the mixer (and cable) that could be as far as 200 feet away. This would reduce the level going to the amplifier.

### **Why is loading no longer the main concern?**

Back in the 1970's and 1980's, acoustic guitars did not have the sophisticated pick-ups and built-in pre-amps that are standard today. Electric basses now incorporate high-output pick-ups or have active electronics built in. Keyboards inherently have high output levels. These high output levels are so powerful; loading is no longer the concern. This 'fix' has in fact caused a new problem; input distortion or saturation.

### **What makes the Radial J48 so special?**

Let's begin by understanding how active DI's work: Active direct boxes are in fact signal preamplifiers. They boost the instrument's signal to a manageable level. This means that active direct boxes require power to run. As such, they must either get their power from batteries or phantom power from the console.

When using batteries, for the direct box to work properly, the batteries must be fresh. As soon as the power is low, the direct box will distort. This is why engineers hate batteries, and prefer phantom power. But phantom has limitations....

Phantom power was originally developed to supply low-current condenser microphones. Back then, no one ever figured that we would have to manage the high dynamic levels of today's active instruments. We recently tested a Takamine acoustic guitar with built-in pre-amp and found that when pushed to the max, the output peaked at 7 volts. Considering that most DI's can barely manage 2 to 3 volts, its no wonder guitars often sound harsh in a PA system. Active basses push the DI's further due to their powerful low frequency content and keyboards (especially digital pianos) are even more demanding.

The Radial J48™ was specifically designed to solve this problem by boosting the internal rail voltage so that these instruments would not be able to overload the input. The J48™ can be hit with as much as 10 volts and still sound great! This is called headroom.

### **How does Radial increase the rail voltage?**

We take the input voltage and drive it through a special custom made DC-to-DC transformer. The transformer is coupled to a timing chip that essentially drives the signal the same way as the newer 'switch mode' or 'digital' power amplifiers work. This brings the current up to a workable level and creates a higher internal rail voltage to handle the dynamics. This allows the signal to stay out of the 'danger zone' where square wave distortion may be encountered.

### **Why does the LED not stay on?**

We felt that every milliwatt of available power should be diverted to provide maximum sound quality since phantom power has very little available current, we felt that lighting up an LED that requires almost as much current as the whole J48™ circuit would not be wise. For the most part, direct boxes tend to be placed under keyboard racks or behind amplifiers and you can't see the light anyway.

### **Why do people use passive direct boxes?**

Passive direct boxes are often chosen as they are 'plug & play' easy to use. When equipped with a high quality transformer, they can handle exceptionally high signal levels without harmonic distortion. A good one like the Radial JDI™ will process the signal without introducing artifacts such as phase distortion. This is achieved because the Jensen Transformer we use is extremely well made.

### **What is phase distortion?**

Keeping your signal in-phase is akin to making sure that when you play guitar, the sound coming from the low E string plays at the same time as the G string when it comes out of your amp. You may take this for granted but the fact is, phase distortion can cause an instrument to get lost in the mix and make a bass sound muddy. Phase distortion can occur at all frequencies but is most noticeable in the bass or low frequencies. Try facing your stereo speakers close together and reverse the wires on one cabinet so that it is wired 'out of phase' and you will immediately become an 'in-phase disciple'.

When we tested several popular direct boxes, we found that most were fine at 1kHz. What surprised us is how they performed at 20Hz from absolute phase. One popular box was 40° out of phase, while another was 20° out. The best was the Radial JDI™ at a mere 4° while the J48™ comes in at a very respectable 9.8°. We spend thousands of dollars on PA systems to ensure they are time aligned (in phase) while lesser direct boxes ruin the sound even before it gets to the mix position!

### **Is a flat frequency response better than a colored response?**

This is a good question. When buying a large diaphragm condenser microphone, you are not getting a flat mic, but getting a color or flavor for your sound palette. Most studios boast a selection of mics and the sign of a good engineer is 'knowing' which mic to use on what in order to get a particular tone. With direct boxes, it is usually not the case. If the sound of the guitar is not right, one will usually change the guitar not the direct box. Therefore, we believe the role of the direct box is to transport the original signal as faithfully as possible from the instrument to the destination and allow the engineer and producer to make the artistic choices.

Here's more food for thought... Should the direct box manufacturer change the tone? If it makes your Strat sound fat, will it make your Les Paul muddy? We think a properly designed DI should be faithful to the source. The Radial J48™ direct box is natural and uncolored.

### **What about tube direct boxes?**

Tube direct boxes are cool and there is a definite place for them in the recording world. Tube DI's introduce personality to the sound and should be viewed in the same way as one views a large diaphragm microphone.

### **What is the difference between phase and polarity?**

This is often confused. Reversing the polarity means switching the (+) wire with the (-) wire and is an electrical connection. Reversing the phase has to do with the time domain. When a frequency is delayed by 180° and played with the original, it has the audible effect of being out of phase and causing cancellation. Reversing the polarity of a speaker has the same audible effect but at all frequencies.

### **What makes the J48™ better than the rest?**

A good direct box needs to address several facets to be functional: The sound, the feature-set and construction are all essential parts that make up the whole. Let's start with the construction. The Radial J48™ is in fact two boxes in one. The inner skeleton features a 14-gauge welded construction in which the PC board, circuit, transformer and switches are housed. Pick up the J48™ and you know you are dealing with quality. The rigid design ensures that there will not be any stress on the PC board and the solder joints will remain intact even after years of use. The outer book-end design provides easy access to the connectors while creating a natural protective zone for the switches. In the real world of concert touring, DI boxes are stepped on and abused. Radial direct boxes must be able to stand up to the abuse. No other DI box offers as many features. This makes the J48™ practical in pretty much any application. **Finally, the sound of the J48™ is 'not'.** Check out the specification and you will find that it is extremely linear from 20Hz to 20kHz, it exhibits almost no distortion in the most rigorous and demanding 20Hz region and with extremely low phase distortion throughout the audio bandwidth, what you put in – you get out. Nothing added, nothing changed.

### **Why choose a Radial direct box?**

Passion and quality. We believe that today, what is missing in many products is a passion to build the product right. We are passionate about producing products that not only exceed the sonic norms, but also exceed the durability expectations.

## **RADIAL ENGINEERING 3-YEAR LIMITED WARRANTY**

Radial Engineering (a division of J.P. Cabletek Electronics Ltd.) warrants this product to be free from defects in material and workmanship to the original owner and will remedy any such defects free of charge according to the terms of this warranty.

Radial will repair or replace (at its option) any defective component(s) of this product (excluding batteries, finish and wear or tear on components under normal use) for a period of three (3) years from the original date of purchase. In the event that a particular product is no longer available, Cabletek reserves the right to replace the product with a similar product of equal performance or greater value.

To make a request or claim under this limited warranty, the product must be returned prepaid in the original shipping container (or equivalent) to Radial or to an authorized Radial repair center and you must assume the risk of loss or damage.

A copy of the original invoice showing date of purchase and the dealer name must accompany any request for work to be performed under this limited warranty. This limited warranty shall not apply if the product has been damaged due to abuse, misuse, misapplication, accident, or as a result of service of modification by any other than an authorized Radial repair center.

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