

Radial Direct Box Selector Chart – J-Class

The following chart provides a quick reference to help select the appropriate direct box for popular instruments and audio sources. Note that these are merely suggestions as many engineers will chose a direct box based on artist preference depending on the application. Also note that the Duplex is a stereo DI and that two JDIs or a single JDI merged to mono will also work. Furthermore, the JDV Super DI will work in almost all applications but for the purpose of this selector chart, we have chosen to reduce the options to minimize confusion. Should you have more questions about applications, we suggest you consult the Radial web site.

Application	JDV	J48	JDI	Duplex	JPC	J33
Acoustic guitar - active	▲	▲	▲			
Acoustic guitar - piezo	▲					
Electric guitar - direct	▲	▲				
Electric guitar – from amp			▲			
String violin/viola - piezo	▲					
Bass - Upright with Piezo	▲					
Bass - passive	▲	▲	▲			
Bass - Active	▲	▲	▲			
Keyboard - electronic	▲	▲	▲	▲	▲	
Keyboard - digital piano	▲		▲	▲		
Keyboard - Rhodes	▲	▲				
Drum machine	▲		▲	▲	▲	
Digital sampler	▲		▲	▲	▲	
DJ Mixer				▲	▲	
Turntable						▲
CD player				▲	▲	
DVD player				▲	▲	
i-pod					▲	
Portable computer				▲	▲	
Sound card				▲	▲	
Backing tracks			▲			
Headphone output			▲			

Radial Direct Box Selector Chart – Pro series

The following chart provides a quick reference to help select the appropriate direct box for popular instruments and audio sources. Note that these are merely suggestions as many engineers will chose a direct box based on artist preference depending on the application. Also note that the ProD2 is a stereo DI and that for stereo sources, two ProDIs will also work. Should you have more questions about applications, we suggest you consult the Radial web site.

Application	Pro48	ProDI	ProD2	ProAV1	ProAV2
Acoustic guitar - active	▲	▲			
Electric guitar - direct	▲				
Bass - passive	▲	▲			
Bass - Active	▲	▲			
Keyboard - electronic	▲	▲	▲	▲	▲
Keyboard - digital piano		▲	▲	▲	▲
Keyboard - Rhodes	▲				
Drum machine		▲	▲	▲	▲
Digital sampler		▲	▲	▲	▲
DJ Mixer			▲		▲
CD player			▲	▲	▲
DVD player			▲	▲	▲
i-pod				▲	
Portable computer			▲	▲	▲
Sound card			▲	▲	▲
Backing tracks		▲	▲		▲

Radial Direct Box Selector Chart – Discussion paper

So many direct boxes... so little time! Inevitably, the big question we get all the time is which *direct box do I use for what?* This is essentially the same question as asking *which microphone is best for a given application.* The answer is simple: it depends. So many factors come into play when selecting a microphone or a direct box as these are the primary interfaces that connect an instrument or voice to the PA or recording system. A dynamic mic is often the popular choice for a snare drum but you may prefer the sound of a condenser for more snap. The same applies to a direct box. Active DIs tend to have more 'reach' just like a condenser while passive DIs tend to naturally 'round out' the sound like a dynamic mic. Old vintage preamps that combine transformers with active class-A drive circuits seem to have a certain character that sets them apart from their contemporaries. This can be good and bad depending on the voice or instrument being processed. These same rules apply to direct boxes... in that *there are no rules*; just options. This paper presents these options as a baseline from which to make artistic decisions.

What is a direct box anyway?

The DI has a principle task of converting the high impedance of an instrument to a balanced low impedance to allow longer cable runs without adding noise. Most DIs are equipped with an input for the instrument, a thru-put for the musician's amplifier and an output that goes to the PA system. Proper impedance matching provides a more natural tone while balancing eliminates noise. The output of a direct box is always mic level so that it can be connected to the same system as the microphones without concern for overload or signal mismatch.

Passive direct boxes

In the beginning, all direct boxes were passive and they used a transformer as the engine. Therefore, they did not require any electrical powering to make them work. Transformers have several positive traits: Unlike active circuits that go from zero to 100% distortion when the input signal exceeds their working rail voltage, transformers saturate. This yields a smooth transition and creates a 'natural limiter' that rounds out the tone of excessively dynamic instruments and removes the digital 'edge' that is often harsh. Transformers also provide electrical isolation which makes them particularly good at eliminating buzz and hum caused by ground loops. The downside to transformers is that since they are passive, they have no 'power assist' to drive instruments. Therefore, low output instruments like vintage Fender basses tend to lose punch when presented with the low input impedance of a passive device.

Active direct boxes

Active direct boxes were developed as a means to provide higher input impedance than that of a transformer to allow vintage instruments and piezo electric pickups to be connected without loss. Active direct boxes are in fact preamplifiers. And like any preamp or mixing console, the more headroom the lower the distortion. Headroom is directly proportional to the working internal rail voltage of the preamp and in general, the beefier the power supply, the better. Selection criteria for active direct boxes will vary depending on where they are going to be used. For instance on a live stage, the convenience of 48V phantom power provides a compelling advantage as bringing local AC power adjacent to the instruments can add another level of complexity on a stage. In the less hectic studio environment, access to local power is generally not a problem.

Active sources

Generally speaking, active sources such as instruments with built-in battery powered preamps, electronic keyboards, CD players and so on tend to have tons of level available at their output. Because they can be quite loud, they tend to overload most active direct boxes. As such, passive direct boxes are often preferred for active sources as they are more forgiving. When active sources are plugged into the wall for AC powering, they can also introduce ground loops into the audio system. Passive DIs inherently isolate the

input from the output making them particularly good at suppressing common-mode noise, a problem commonly known as ground loops which of course is the main contributor to buzz and hum in a sound system. For bass and acoustic guitars, the added sparkle of an active DI is often preferred. This is why the Radial J48 is often preferred for these instruments. (Remember: no rules!)

Passive sources

Old vintage basses, Rhodes pianos, piezo electric pickups and other instruments that do not have any form of internal powering tend to be best served with an active direct box. The higher the input impedance; the lower the load will be applied on the instrument. But be careful... the higher the input impedance, the more difficult it is to amplify the source without adding noise! For the most part, anything above 100kOhms to 4MegOhms is considered to be a high input-impedance. Listening tests have found that a 200kOhms impedance provides a good sounding average for most instruments while 3 to 4MegOhms tends to work well for piezo electric contact pickups. The Radial JDV is equipped with Drag Control, a variable impedance that lets the engineer adjust the load to suit.

Eliminating system noise

In hectic environments such as live stages, time is precious and eliminating system noise is a nightly challenge that can sometimes be easy to resolve while other nights it seems impossible. For the experienced technician, the preferred direct box is generally passive due to the inherent advantage of transformer isolation which in turn, eliminates hum & buzz in the system. A critical factor that is often ignored in eliminating noise is transformer shielding from extraneous magnetic fields. The very nature of a transformer is that it provides a magnetic bridge between the primary and secondary coils thus completely disconnecting the source and destination. In the real world outside of the laboratory, direct boxes are placed on top of guitar amplifiers with huge power transformers that emit a powerful magnetic field. Unless this magnetic field is kept out of the direct box transformer, it will affect the transmission path by introducing noise and likely cause phase and frequency shift. Both the Radial JDI and ProDI passive direct boxes employ a solid steel housing with an additional mu-metal protective can surrounding the transformer to keep unwanted magnetic fields out.

Headroom

As described earlier, probably the most telling difference between active direct boxes (preamps) is the available headroom. Headroom is basically the direct box's ability to handle large transients and dynamics without choking. Most typical mid to low priced mixing consoles have a working range of between 14V to 16V while high end large format live performance and recording consoles have a working voltage in the 24V range. More headroom equates to more horsepower. When you have more headroom, you are not constantly 'red-lining' the engine and therefore the sound will be smoother and more natural. With active direct boxes, the power source tends to be a major limiting factor to headroom. 48V phantom power was originally developed in the 1960s by Georg Neumann to provide a remote polarizing voltage for his microphones. Never did he envision that phantom power would be used to power a remote preamplifier. Because phantom power is limited to 0.005 amps of current, there is in fact very little power available to develop headroom and this is why most active DIs are limited to 1 or 2 Volt rails. The Radial J48 and Pro48 employ a digital switching power supply to increase the rail voltage to 9 Volts so that more headroom can be enjoyed. The Radial JDV employs a stand-alone 42V power supply that produces an astounding 30 Volts of headroom.

Keep it simple stupid

Often times, stereo reproduction during a live event is not required. To enjoy a stereo field, one really must be seated in the center sweet spot or mix position. In most large venues, the PA system is designed to provide a balanced sound to all of the seats and this makes stereo a practical impossibility. Several Radial direct boxes are equipped with a stereo to mono function called Merge that is

in fact a resistive mixing circuit. This is ideally suited for stereo keyboards or computer sound files that can quickly fill up every channel of a snake and mixer. The ProAV1 automatically merges all of the stereo inputs to mono for this very reason.

Keyboard racks

When multiple keyboards are being used, these tend to be best supported by rack-mounting the direct boxes. The Radial J-Rak provides a 2 rack-space solution that allows up to 8 direct boxes to be rack mounted. If one were to use 8 of the Radial ProD2s, as many as 16 individual DI channels would be available. The advantage of using the J-Rak is that it allows rental companies with a means to employ the same direct boxes in a variety of applications and improve inventory management. Alternately, one can also select between two single rack-space DIs; the Radial JD6 and the Radial ProD8. The JD6 employs six Jensen transformers while the ProD8 employs eight of the more affordable Radial custom transformers. Both are outfitted with slightly different features while the ProD8 is also equipped with reversible rack rails to allow front or rear access to the connectors. In both cases, these DIs are passive as today's keyboards are generally high output active devices.

Backing tracks

More and more, backing tracks are becoming the norm in concert touring. These tend to be generated from stand-alone digital recorders as they tend to be more rugged than computers and set-up to rack mount. As disaster is always lurking around the next corner, professional touring technicians usually have a backup on stage. The Radial ProD8 allows both the main and backup recorders to be connected together and merged mono. By setting recorder-1 to play and recorder-2 on mute and syncing them together, system 2 is 'ready' to be switched on should ever system one go down.

Using a DI as a problem fixer

One of the most common uses for the Radial JDI Duplex is to use it as a problem fixer during hectic live performances. When interfacing various pieces of gear, common mode noise or stray voltages that travel in and around the electrical and audio system can cause noise. The experienced technician knows this and the best way to solve the problem quickly is to introduce a transformer into the signal path. The Duplex is set up with a variety of connector and pad options to allow different signals to be interfaced with minimal distortion. This makes it (and the ProAV1) a great problem solver. For line level to line level isolation, the Twin Iso is the box to use.

The story of a great sounding DI that was not

Not too long ago, we received an email from a fellow in Texas telling us how great the Radial JDV sounded. He went on and on of how he had tried every DI out there and that the JDV completely set his bass sound apart. In fact, the tone was so good, his guitarist who rarely gives praise even commented on how good his bass sounded. In response we told him the truth... it was not that the DI sounded good, it was simply the fact that he had never heard his bass before. This is the task of a great DI. We had the same comments a few years back when a technician for a church in Portland replaced his old DIs with the Duplex on the electronic drum kit. Right after the very first sermon, the pastor came over and asked what he did to make the sound so much better. He replied: nothing... I just put in a new Radial JDI. We believe the job of a direct box is to pass along the signal as faithfully as possible. By reducing noise and eliminating all types of distortion including phase, frequency, harmonic and inter-modulation a funny thing happens... the sound improves. Radial... True to the music!