



# HDI

## High Definition Studio Direct Box



# OWNER'S MANUAL

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# Radial HDI Owner's Manual

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## INTRODUCTION

Thank you for purchasing the HDI, a unique and powerful direct box and studio tool that allows you to create amazing audio for recording or live performance.

We encourage you to read through this manual to familiarize yourself with the many features available on the HDI, allowing you to get the most out of this device. If you have any questions not answered in this user guide, please visit our website at [www.radialeng.com](http://www.radialeng.com) for additional resources and frequently asked questions.

## OVERVIEW

### *A note from the HDI design engineer W.C. "Hutch" Hutchison*

The HDI Direct Box has its roots in the experiences of a live sound and recording engineer. We know what an engineer typically needs to process the signal from a conventional DI to make it sit in a mix. We also know that sometimes that pure clean sound is exactly what is called for and sometimes we wish it sounded more like a great old tube amp. Sometimes, we struggle to make it sparkle the right way and sometimes we struggle to get a big lush rich sound that would be appropriate for this particular song.

In respect to the classic clean-ness of traditional DI's, it had to be clean, but could we make it even cleaner and lower noise than traditional approaches. Could we make it cleaner, and more transparent and truly clear while retaining the musicality? One of the goals of the HDI was to blur the line between musical instrument and recording hardware so that this DI could become an extension of the instrument itself.

Could we give it character and color? Sure. Many are the colors in the spectrum and many characteristics that are not so tasteful. So, the real question was, could we provide a range of colors that seem to be the most appealing and avoid a lot of characteristics that might be useless or just too subtle to make any significant difference to the mix. Even more to the point, will the resulting sound inspire the musician, make the engineer smile and make the listener wanting more of that.

We also wanted it to be simple to use, so that the player or engineer could dial up a perfectly good sound in 5 to 10 seconds and hit the record button. "Instant gratification" is intentional and perhaps the HDI's best "feature". An elegant set of controls is the key to that.

The result of this design process is a studio tool that combines the functionality of a direct box with the musicality of a guitar amplifier, opening up a unique sonic landscape which any instrumentalist can experiment with to create colorful studio recordings and memorable live performances alike.



## FRONT PANEL FEATURES



1. **IN/THRU:** IN (top jack) - Standard 1/4" TS input for mono instruments. When in use this input overrides the rear-panel 1/4" input. THRU (bottom jack) - 1/4" TS unbuffered passthrough to feed the input of a stage amplifier.
2. **HI-Z:** Adjusts the input impedance at the 1/4" inputs for different tonal options when using instruments with passive pickups or piezo transducers. Lower position is 200k Ohms, higher position is 2Meg Ohms.
3. **LEVEL:** Input level control which also allows you to drive the distortion channel of the Color control for greater saturation and coloration. 12 o'clock nominal position
4. **OPTO:** 3-position switch controls an internal opto compressor circuit, providing smooth and natural dynamic control when the Color knob is set to the clean channel (7 o'clock to 12 o'clock range). Note that the Opto LED will only illuminate to indicate when gain reduction is being applied.
5. **COLOR:** Blends between an ultra-clean DI channel (when turned fully counter-clockwise) and a unique distortion channel that adds transformer saturation and amp-like distortion as this control is turned clockwise. The Color control is also dependent on the Level control, which in this case be viewed as a 'drive' control. There is an interesting and often useful range of colors depending on how high the Level control is turned up. Even with the Level control set quite low the Color circuit still brings in some magic, albeit subtler.
6. **HPF:** Three-position switch rolls off low frequencies to compensate for additional low end content when applying distortion via the Color control. Note that this switch only affects signal that has been processed through the distortion channel of the Color control, the HPF does not affect the clean side of the HDI.
7. **PRESENCE:** Adds emphasis to the high and high-mid frequencies. Fully counter-clockwise is flat, turn this control clockwise for an increasingly brighter sound.
8. **LIFT:** Disconnects the HDI audio ground from the chassis ground to eliminate hum and buzz caused by ground loops.
9. **POWER:** On/off switch for the HDI, when powered on the VU Meter LED will illuminate.
10. **OUTPUT METER:** Wide-range highly responsive peak meter corresponding to the signal present at the Line-Level XLR output. The highest marking on the scale of +20 refers to +20dBu, though the HDI is capable of producing max output levels of +25dBu.

## REAR PANEL FEATURES



11. **POWER INPUT:** Connection for IEC power supply cable (included). Ensure the front panel Power switch is in the off (down) position before connecting the HDI to power.
12. **15dB PAD:** Reduces the signal level at the Line-Level XLR output to avoid clipping the input stages of recording interfaces with lower maximum input settings.
13. **LINE-LEVEL OUTPUT:** Independently isolated Jensen transformer-equipped XLR output designed to connect directly to the line-level inputs of a recording console or audio interface, bypassing the need for a separate preamplifier in the signal chain.
14. **MIC-LEVEL OUTPUT:** Typical direct box balanced low-level XLR output, for connection to stage snakes or the mic inputs of a recording console or audio interface. This output follows the Line-Level XLR Output, and features an additional premium Jensen transformer for isolation and signal reduction to mic-level.
15. **PROCESSED OUTPUT:** Unbalanced 1/4" TS output that follows the tone-shaping circuitry of the HDI, allowing you to easily feed an affected signal to a stage amplifier, amp modeling unit, or any device with instrument-level inputs.
16. **SYNTH INPUT:** Mono 3.5mm input for connection to modular synthesizers. This input features a lower sensitivity to accommodate the hotter levels that modular synths typically output. For more level and drive with a mono synth the 1/4" Inputs can still be used. The Synth input may also be useful for bringing in hot line-level signals from a DAC for processing. Connection to this input overrides both 1/4" instrument inputs.
17. **INPUT:** Standard 1/4" TS jack for connection to mono instruments, mirrored on front panel input jack.



## MAKING CONNECTIONS

Before connecting to the HDI, it is always best to turn your audio system levels down in order to prevent plug-in transients that could damage more sensitive components such as high frequency drivers.

### POWERING THE HDI

The HDI features a rear-panel IEC input for the included power supply. Once connected to power, flip the front-panel POWER switch up to the on position: the Output Meter LED will illuminate to indicate that the HDI is powered on and ready for use.

### CONNECTING A MONO INSTRUMENT TO THE HDI

The HDI features both front and rear-panel 1/4" TS inputs for connecting any mono instrument, from bass to acoustic guitar, or any instrument in between. When the HDI is rack mounted, the rear panel input can be used for a hard-wired connection to a patch bay or an input switcher, leaving the front panel input open to allow for spontaneous connection to the HDI without having to repatch any cables. The front panel input takes priority - as soon as an instrument cable is plugged into it, the rear panel input will be automatically disabled.

If you are using an instrument amplifier in conjunction with the HDI in the studio or on stage, a Thru Output is provided to feed a clean split of the input signal to your amp. This output uses a standard 1/4" TS instrument cable.



*Connecting an instrument and an amplifier to the HDI*

### CONNECTING A MONO SYNTH TO THE HDI

The rear panel of the HDI also features a 3.5mm mono Synth Input, allowing an easy access point for instrumentalists that utilize modular synthesizers, and providing the advantages of running their signal through the HDI's unique distortion and transformer saturation circuitry to impart warmth and grit onto their signal. Connect your modular synth to this input using a 3.5mm (1/8") cable - this input will override both 1/4" inputs when connected. This synth input is about 15dB lower than the HDI instrument inputs to compensate for the additional gain provided by the synth outputs. The Synth Input may also be useful for bringing in hot line-level signals from a DAC for processing.



*Connecting a mono synthesizer to the HDI*

### CONNECTING THE OUTPUTS OF THE HDI

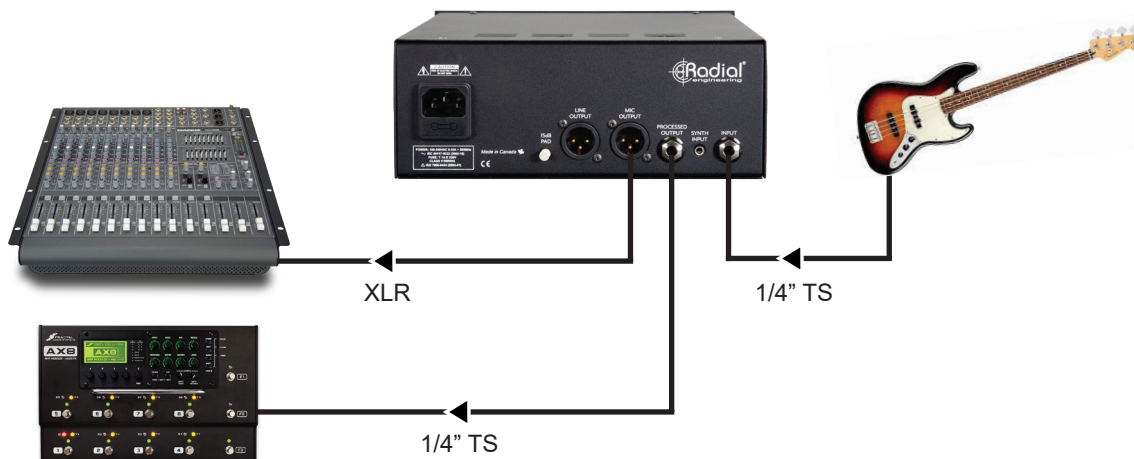
Unlike most direct boxes which only feature a balanced mic-level output, the HDI provides dual XLR outputs: one which is a typical mic-level, and another which provides a line-level signal up to +25dBu. While the mic-level output allows you to connect to microphone snakes on stage or the mic inputs of a mixing board, the line-level XLR output provides the option to bypass an additional preamplifier stage and connect directly to the line inputs of a recording console or audio interface. Both of these connections require balanced XLR cables, which can be run distances up to 100m (300ft) without signal loss or degradation.

The XLR connections on the HDI are individually isolated with premium Jensen transformers, so both outputs can be used simultaneously if desired, allowing you to run the line-level output directly to your recording interface, while feeding the mic-level output through your favorite microphone preamp.



*The HDI's balanced outputs*

The HDI also features a Processed Output, which is an unbalanced 1/4" TS connection that provides the option for signal to be fed to a stage amplifier or an amp profiler unit while retaining the character and tone imparted by the front panel controls of the HDI. This can be used to add distortion and saturation before feeding a clean amplifier, or to impart some transformer warmth before connecting to a digital amp modeler. The Processed Output can be used at the same time as the balanced XLR outputs and the front panel Thru output.



*Using the HDI Processed Output*

### USING THE FRONT PANEL CONTROLS

Once you've made all your connections, it's time to put the main feature set of the HDI to use. While this device has been designed to be easy to get great sounding results in a matter of seconds, this section of the manual should provide a useful guide to getting the most out of the HDI. As a general rule of thumb, it helps to start by moving left-to-right across the front panel controls for your initial adjustments.

To begin, start with each of the control knobs turned all the way down (fully counter-clockwise), and all of the switches set to their lowest position.



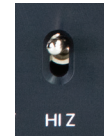
*Initial front panel settings*

## USING THE FRONT PANEL CONTROLS CONTINUED



### HI-Z

The HI-Z control adjusts the impedance of the front and rear panel 1/4" Inputs. This switch mirrors the functionality of older amplifiers which have Hi and Low inputs, giving you greater tonal flexibility when using instruments with passive pickups or piezo transducers. In the lower position the input impedance of these jacks is 200k Ohms, while the upper position increases this to 2Meg Ohms. Once you have adjusted the other settings on the HDI, you can try an A/B comparison test between the higher and lower input impedance, as you may find that this will affect the resonance of your pickups and result in a brighter sound that may complement the sound of your instrument.



### LEVEL

The Level control provides an input gain stage for the HDI: turning up this knob will drive your signal harder into the Opto compressor and the distortion channel associated with the Color control. The remaining controls on the front panel will have minimal impact on the amount of gain applied to the signal, so the Level control is also helpful for setting your output levels, which are displayed on the Output Meter.

### OPTO

The Opto switch is a 3-position control for the internal opto compressor circuit. In the lowest position, this feature is bypassed. The middle and upper positions of this switch will both apply smooth compression to the clean channel of the Color control, providing a 'safety switch' for the engineer to control any large jumps in level during a performance. The difference between the middle and upper positions of the switch is that the upper position has the lowest threshold for gain reduction, meaning that the compressor will kick in sooner at this setting.



Note that the LED for the Opto compressor does not illuminate when the switch is engaged - this LED actually indicates when gain reduction is being applied, and the brighter the LED shines, the more gain reduction is occurring. Also keep in mind that the Opto circuit only works on the clean channel of the Color knob: as you turn the Color control clockwise towards the distortion channel, less of the clean channel will be present in the output of the HDI, and therefore the Opto LED will illuminate less and less the more the Color control is turned up.

### COLOR

The Color control itself is the heart of what makes the HDI unique, and will most likely be the control you spend the most time tweaking to explore the various tonal possibilities it can provide. As previously mentioned, the Color control can be thought of as a blend between two parallel channels within the HDI: on the left side (fully counter-clockwise) there is the ultra-clean channel, which is designed to let the natural tone of your instrument shine through with as little coloration as possible, while the right side (fully clockwise) incorporates a number of effects that result in a saturated and pleasantly distorted signal that complements any instrument nicely. Both sides implement an oversized custom Jensen transformer to help achieve these unique results.

The most effective way to use this control is by actively listening to the output of the HDI as you sweep through the settings from clean to distorted, as the position you end up at is entirely dependant on the tonal qualities of the instrument, the style of the musician, and how it fits in with the rest of the performance. Note that the Color control can vary from subtle to quite noticeable - should you find that the effect is too subtle for your taste, try turning up the Level control a little higher, as this acts as a drive control for the distortion channel.



### ***Under the hood: The Color control***

In clean mode, with the Color knob turned more towards the counter-clockwise side of the dial, a substantial amount of negative feedback is applied after the Jensen transformer, helping to correct for any resulting coloration and providing an incredibly transparent, transformerless sound.

As the Color knob is turned clockwise towards the distortion channel, this transformer is instead driven into variable saturation, and a separate winding is biased as the knob is turned up, which increases even-order harmonics. This is particularly pronounced in the low frequencies.

This transformer saturation is only a part of the design of the distortion channel, as the main component implements a multi-stage circuit topology similar to that of a tube based guitar amplifier, including triode gain stages and a phase splitter. This tube amp topology employs asymmetrical clipping, where the last stage distorts first, and as the input levels are increased, earlier stages of the circuitry begin to clip as well, reacting much the same way as a typical amplifier would, and resulting in a very natural and musical sounding level of grit and distortion.

### **HPF**

Following the Color control is a 3-position switch that adjusts the High-Pass Filter settings. This control is designed to help compensate for the additional low frequency content which can build up when certain types of distortion and saturation are applied to the signal. For this reason, the HPF only affects signals processed through the distortion channel of the Color control: signals processed through the clean side of the HDI are unaffected by this switch.



When the Color control turned clockwise to add saturation and distortion, engaging the HPF can often provide an instant solution to help the resulting sound fit better within a mix. In the lowest position, this feature is bypassed: the middle position rolls off frequencies below 40Hz, and the top position rolls off from 100Hz. Both rolloffs have a slope of -6dB/octave.

### **PRESENCE**

The final variable adjustment on the HDI is the Presence control, which emphasizes the high and high-mid frequencies to provide some additional bite to the signal and allows it to cut through a mix when blended with a number of other tracks. This control is flat and has no effect on the signal when fully counter-clockwise: as you turn it up more and more, you continue to increase the high frequency content at the outputs of the HDI.

### **LIFT**

Between the Presence control and the Power switch is a Ground Lift switch, designed to help eliminate hum and buzz caused by ground loops. This switch disconnects the HDI audio ground from the chassis ground (which is also AC third pin ground). XLR Pin 1 on both of the HDI outputs is always connected to the chassis ground. There may be occasions where a modified XLR cable with shield disconnected from pin 1 on one end helps solve a ground loop issue. This is standard practice and the AES recommendation is to disconnect at the destination or MALE XLR on the cable if a ground loop is causing hum

Both the mic-level and line-level XLRs are individually transformer-isolated, which can often remove most ground loop noise, but should you encounter any additional noise when these outputs are connected, simply move the Lift switch to the upper position to help further alleviate the issue.



### THE REAR PANEL PAD SWITCH

After spending some time adjusting the front panel controls to find your optimal tone through the HDI, you may find that the Line-Level XLR output is too hot for the inputs of the next device in your signal chain, whether it is a recording interface or another line-level signal processor. The HDI is capable of producing up to +25dBu at the Line-Level output, which can sometimes distort the inputs of other audio equipment.

While it is possible to lower the output of the HDI by turning down the Level control, this in turn will cause less saturation on the distortion channel of the Color control, and can alter the resulting tone that you've carefully constructed.

The 15dB pad on the rear panel of the HDI offers an alternative solution: engaging this switch will lower the Line-Level output only while preserving the relationship between all of the front panel controls, allowing you to avoid distorting your audio interface while keeping your tone intact.



The 15dB Pad switch

### RACK MOUNTING THE HDI

The HDI can be used as a standalone device or it can be mounted in standard 19" equipment racks using the included rackmount adaptors. The HDI takes up 2 rack units of space and can be mounted left or right-aligned depending on the orientation of the two mounting brackets. Two HDI units can also be mounted side by side in a single 2RU rackspace using the additional connector bracket: use this to affix both chassis' to each other before attaching the rack ears.

### ADDITIONAL APPLICATIONS

While this manual has discussed the general use cases for the HDI, this unique product can be used in a number of other creative ways. This section briefly describes some additional applications for the HDI.

Overdrive a mic preamp with the HDI - feed the line-level output of the HDI into your favorite microphone preamp (start with your levels turned down). Some preamps can sound wild when overdriven. Try following the preamp with a high-pass filter set at around 8kHz, or alternatively try using the impulse response of a guitar cabinet after the preamp.



Using the HDI to overdrive a microphone preamp

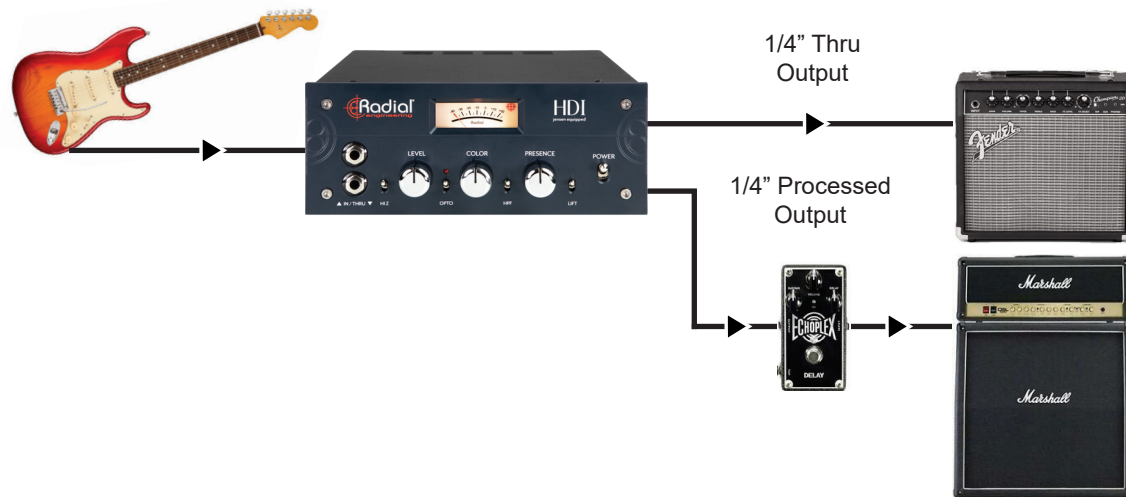
### ADDITIONAL APPLICATIONS CONTINUED

Using distortion pedals before or after the HDI - You can use standard distortion pedals in front of the HDI to generate some interesting tones, or try connecting the 1/4" Processed Output into a distortion pedal or chain of pedals that then feed a guitar amplifier.



*Connecting an instrument and an amplifier to the HDI*

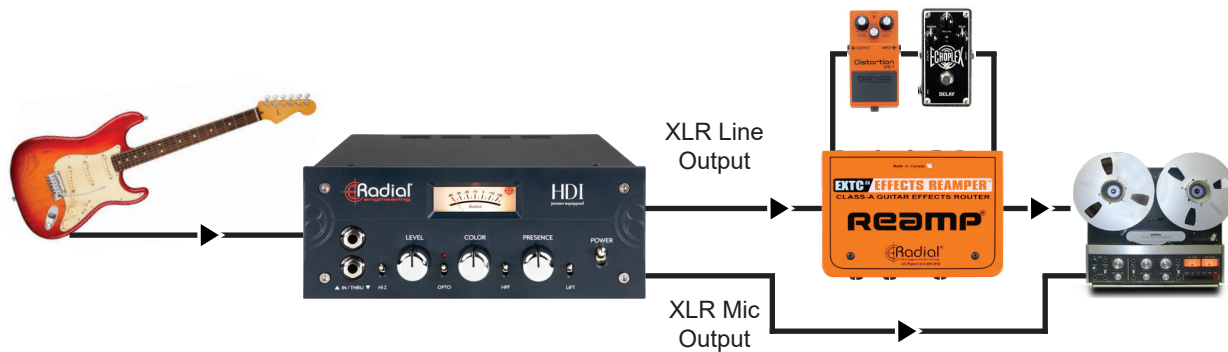
Using the 1/4" Processed Output in conjunction with the Thru Output - While the 1/4" Thru connection would typically feed your stage amplifier, try connecting an echo pedal to the 1/4" Processed Output and feeding this signal to a second amplifier, producing a wet/dry setup with the HDI.



*Connecting a second amplifier to the HDI*

## ADDITIONAL APPLICATIONS CONTINUED

Use the EXTC-SA with the HDI - With the help of the EXTC-SA, you can simultaneously record to two channels on your recording interface, one that includes your favorite pedals, and another that includes only the tone from the HDI. The EXTC-SA has line-level inputs and outputs, while also allowing you to directly connect up to two effects loops with guitar pedals directly to the unit. This allows you to use the HDI line-level output to feed your effects pedals while the HDI mic output sends a clean signal to your recording interface. Try blending the two tracks together or shifting the phase for a unique sonic combination.



*Using the HDI in conjunction with the Radial EXTC-SA*

**NOTES:**



NOTES:

**HDI SPECIFICATIONS\***

**SPECIFICATIONS**

Frequency Response - Line Output:..... 1Hz ~ 100kHz +0.25/-3dB, 20Hz ~ 20kHz +/-0.1dB  
 Frequency Response - Mic Output:..... 10Hz ~ 80kHz +0.25dB/-3dB  
 Dynamic Range: ..... 112dB (20-20k, unweighted, referred to +25dBu)  
 S/N Ratio: ..... 91dB (20-20k, unweighted, referred to +4dBu)  
 THD+N: ..... 0.3% @20Hz, 0.22% @100Hz, 0.01% @1kHz (+4dBu In)  
 Minimum Gain - Level CCW: ..... -3dB  
 Maximum Gain - Level CW:..... +31dB  
 Max Input 1/4" TS: ..... +5dBu, 3 VAC RMS, 8.4 V Peak to Peak  
 Max Input 3.5mm:..... +25dBu, 7 VAC RMS, 20V Peak to Peak (Level @ 12:00)  
 Max Output Line-Level XLR: ..... +25dBu (1% THD at 1kHz)  
 Max Output Mic-Level XLR:..... +3.7dBu (1% THD at 1kHz)  
 Max Output 1/4" Processed Out: ..... +8dBu (Approx. unity gain with Level @ 12:00)

**FEATURES**

Level, Color, Presence, Ground Lift, -15dB Pad, Output Meter  
 Input Connectors: ..... 1/4" TS (front and rear), 3.5mm Synth  
 Output Connectors: ..... XLR Line / Mic, 1/4" TS Processed, 1/4" TS Thru  
 Hi-Z:..... 200k  $\Omega$  / 2Meg  $\Omega$  @ 1/4" Inputs  
 Opto:..... 6:1 ratio, max 8dB gain reduction  
 High-Pass Filter: ..... 40Hz / 100Hz rolloff @ -6dB/octave

**GENERAL**

Construction: ..... 14 gauge steel chassis, 1/2" aluminum front panel  
 Size (L x W x H):..... 8.25" x 8.25" x 3.5"  
 Weight: ..... 5.05lbs  
 Conditions:..... For use in dry locations only between 5°C and 40°C  
 Power: ..... 100-200VAC 0.45A ~ 50/60Hz  
 Conformity: ..... CE  
 Warranty: ..... Radial 3-year, transferable

\*Specifications are subject to change without notice.

**RADIAL ENGINEERING LTD.  
3 YEAR TRANSFERABLE WARRANTY**

RADIAL ENGINEERING LTD. ("Radial") warrants this product to be free from defects in material and workmanship 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 finish and wear and 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, Radial reserves the right to replace the product with a similar product of equal 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 and transferable 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 or modification by any other than an authorized Radial repair center.

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To meet the requirements of California Proposition 65, it is our responsibility to inform you of the following:

**WARNING:** This product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

Please take proper care when handling and consult local government regulations before discarding.

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