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**Sound System Interconnection****DC 24 Data Sheet****Circuit Board Layout****Schematics****Rane Full Line Catalog****Warranty****IMPORTANT SAFETY INSTRUCTIONS**

For the continued safety of yourself and others we recommend that you read the following safety and installation instructions. Keep this document in a safe location for future reference. Please heed all warnings and follow all instructions.

Do *not* use this equipment in a location where it might become wet. Clean only with a damp cloth.

This equipment may be installed in an industry standard equipment rack. We recommend that all mounting holes be used, providing the best physical support. The equipment may be used as a table top device, although stacking of the equipment is dangerous and not recommended.

Do not directly block any of the ventilation openings. If rackmounting, please provide adequate ventilation. Equipment may be located directly above or below this unit, but note that some equipment (like large power amplifiers) may cause an unacceptable amount of hum or may generate too much heat and degrade the performance of this equipment.

Protect the power cord and plug from damage caused by being walked on or pinched. Protect the line cord, where it exits the unit, from excessive strain.

Only use attachments and accessories specified by Rane.

Unplug this equipment during lightning storms or when unused for long periods of time.

Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power supply cord or plug damage, spilled liquid, fallen objects into an opened chassis, exposure to rain or moisture, a dropped unit, or abnormal operation.

For 230 V Units

## Declaration of Conformity

**Application of  
Council directive(s):**

73/23/EEC  
89/336/EEC

**Standard(s) to which  
conformity is declared:**

EN60065:1998  
EN55103:1990, EN55020:1995 or EN55103-1-2:1997

**Manufacturer:**

Rane Corporation  
10802 47th Avenue West  
Mukilteo WA 98275-5098 USA

This equipment has been tested and found to be in compliance with all applicable standards and regulations applying to the EU's Low Voltage (LV) directive 73/23/EEC, and Electromagnetic Compatibility (EMC) directive 89/336/EEC. In order for the customer to maintain compliance with this regulation, high quality shielded cable must be used for interconnection to other equipment. Modification of the equipment, other than that expressly outlined by the manufacturer, is not allowed under this directive. The user of this equipment shall accept full responsibility for compliance with the LV directive and EMC directive in the event that the equipment is modified without written consent of the manufacturer.

**Type of Equipment:**

Professional Audio Signal Processing

**Model:**

DC 24

*I, the undersigned, hereby declare that the equipment specified above conforms  
to the Directive(s) and Standard(s) shown above.*



(Signature)

John A. Ott

(Full Name)

Compliance Engineer

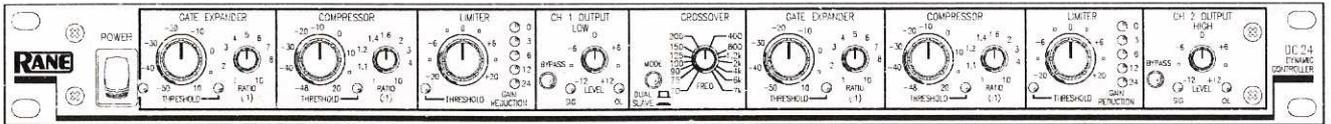
(Position)

June 22, 1995

(Date)

Mukilteo WA USA

(Place)



### QUICK START

Shredded, this document makes excellent packing material. In its present form, it makes interesting and useful reading. If you run out of patience quickly, at least read this part to make sure you don't exterminate everything in a two mile radius by doing something wrong.

In a nutshell, to use the DC 24 as a conventional dual channel compressor/limiter, ensure that the **CROSSOVER ENGAGE** switch on the rear is in its *out* position. Attach one or two channels of inputs and outputs to the respective connectors on the rear. With all **RATIOS** down, **LIMITER THRESHOLD** all the way up and the **LEVEL** controls in *center-detent* you have an expensive patch cord. Make sure the **BYPASS** switches are *out* and set the **GATE** and **COMPRESSOR** for the desired ratios and thresholds. Turning the **LIMITER THRESHOLD** down decreases the level at which limiting occurs. The **GATES** and **COMPRESSORS** may both be activated by the source material applied to Channel 1 if the **DUAL/SLAVE** switch is pressed *in*. This is a normal condition for true stereo program material.

To use the DC 24's crossover bandsplit mode, be sure the rear panel **CROSSOVER ENGAGE** switch is *in*. Connect the input to **CH 1/CROSSOVER IN**. With the rear panel **OUTPUTS** switch set to **SEPARATE**, split outputs are available at the **CH 1/LOW OUT** and **CH 2/HIGH/COMBINE OUT** jacks. With the **OUTPUTS** switch at **COMBINE**, use only the **CH 2/HIGH/COMBINE OUT** jack for a mono sum of high and low channels.

**NEVER CONNECT ANYTHING EXCEPT AN RS 1 OR OTHER APPROVED RANE AC POWER SUPPLY TO THE THING THAT LOOKS LIKE A TELEPHONE JACK ON THE REAR OF THE DC 24.** This is an AC input and requires some special attention if you do not have an operational power supply **EXACTLY** like the one that was originally packed with your unit.

### DC 24 CONNECTION

Placing the DC 24 within the chain of events in your system varies slightly depending on application. If you are assembling a sound reinforcement system, the DC 24 would typically be placed between the equalizer (you do use one, don't you?) and the active crossover, or the power amplifier if passive crossovers (or the DC 24 crossover) are used.

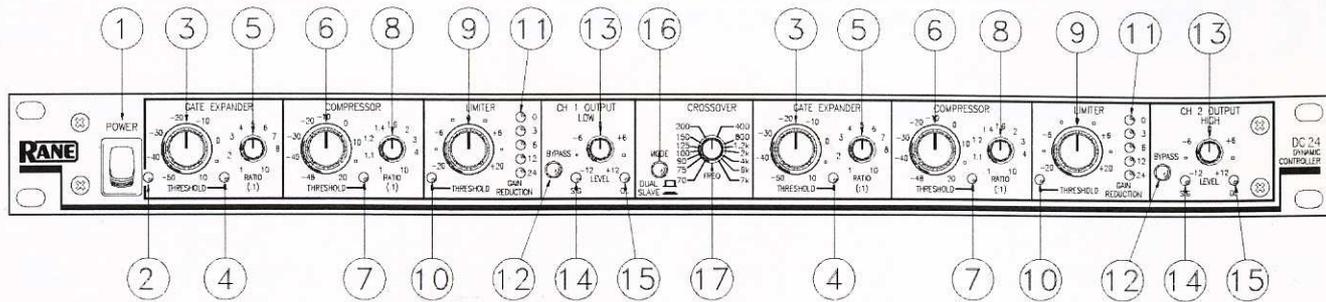
In recording applications, the DC 24 may be used in conjunction with insert loops on the mixing console or in series with the outputs en route to the recorder. Most consoles allow headphone monitoring of the processed signal if the device is connected to the inserts. A most useful feature. If the DC 24 is used on mixdown, it may be connected to the

output of the multichannel recorder or again on inserts of the mixdown console.

Many recording situations require that the DC 24 be connected to the patch bay in the system so it may be easily moved from one signal location to another. This call should be made based upon the requirements of the application.

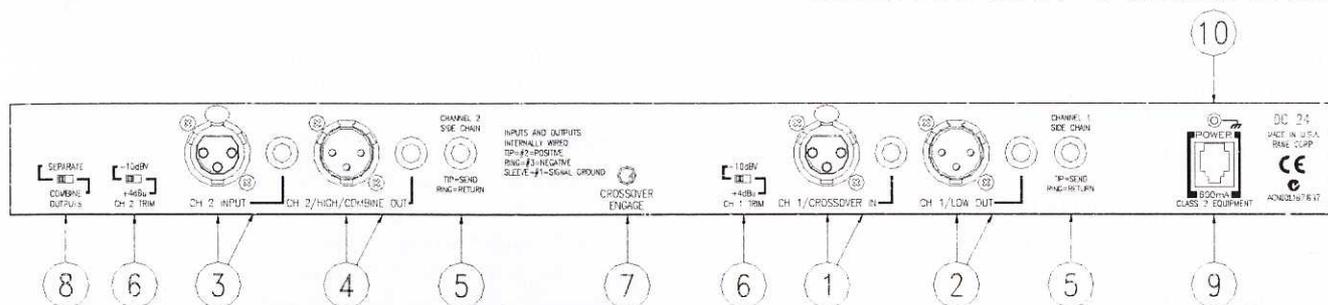
Wiring of this and all components should follow the Sound System Interconnection RaneNote included in this manual. This note details standard wiring conventions which should be used to prevent noise and distortion. Also see the Chassis Ground note on page Manual-3.

## FRONT PANEL DESCRIPTION



- ① **POWER switch:** It has been a tradition at Rane Corporation to say something clever about the POWER switch on all its products. Certain government restrictions now eliminate our option of continuing this tradition. Pity.
- ② **POWER indicator LED:** This solid-state yellow illumination device lights up to let the operator know Item 1 (above) is working and the thing is plugged in.
- ③ **GATE/EXPANDER THRESHOLD control:** allows the operator to set the input level below which the Gate/Expander operates.
- ④ **GATE/EXPANDER THRESHOLD LED:** illuminates yellow any time the input signal falls below the threshold level set by its neighboring knob to the immediate left.
- ⑤ **GATE/EXPANDER RATIO control:** determines the Ratio to be applied to the Gate/Expander function. Increased clockwise rotation increases the circuit slope. The full counter-clockwise position disables the Gate/Expander.
- ⑥ **COMPRESSOR THRESHOLD control:** determines above what input level the Compressor functions. Full clockwise rotation disables the Compressor entirely.
- ⑦ **COMPRESSOR THRESHOLD LED:** illuminates yellow any time the input signal exceeds the level at which the COMPRESSOR THRESHOLD control is set.
- ⑧ **COMPRESSOR RATIO control:** determines the slope of the Compressor once it has exceeded the indicated threshold. Full counter-clockwise rotation of the RATIO control disables all Compressor activity.
- ⑨ **LIMITER THRESHOLD control:** determines above what level the Servo Locked Limiter™ functions. Full clockwise rotation of this knob disables all Limiter activity.
- ⑩ **LIMITER THRESHOLD LED:** illuminates red any time the input exceeds the LIMITER THRESHOLD setting.
- ⑪ **GAIN REDUCTION meter:** indicates the amount of reduction, below unity, being applied to the audio signal by the VCA.
- ⑫ **BYPASS switch:** When pressed *in*, this Channel in the DC 24 is hard-wire Bypassed. Each Channel may be individually Bypassed for comparison and alignment purposes. See OPERATING INSTRUCTIONS on page Manual-4.
- ⑬ **OUTPUT LEVEL control:** increases or decreases the output gain of each Channel by 12 dB. In the center detent, gain will be unity. (NOTE: Channel 2 OUTPUT LEVEL controls overall output in COMBINE mode.)
- ⑭ **SIGNAL present LED:** illuminates any time the input signal exceeds approximately -40 dBu.
- ⑮ **OverLoad LED:** illuminates any time the output exceeds a level equal to -4 dB below the clipping level.
- ⑯ **DUAL / SLAVE mode switch:** In the *in* (SLAVE) position, this switch causes both Channels' Gate, Compressor and Limiters to act together, i.e., they are "slaved." All controls for both Channels remain active, so independent settings are still possible; however, whenever a signal in one Channel exceeds its settings, then *both* Channels change by the same amount. In the *out* (DUAL) position, both Channels operate independently.
- ⑰ **CROSSOVER FREQUENCY control:** This rotary control selects the crossover frequency. What did you think?

## REAR PANEL DESCRIPTION



- ① **CHANNEL 1 INPUT connectors:** deliver signal to both Channel 1 of the processor and to the crossover circuit. Choose either the XLR or the 1/4" TRS jack, do not use both, they do not sum.
- ② **CHANNEL 1 / LOW PASS OUTPUT connectors:** deliver signal from Channel 1's processing circuitry and represents the low pass portion of the signal when the CROSSOVER ENGAGE switch (7) is in the *in* position. Both the XLR and the 1/4" TRS jack may be used if desired.
- ③ **CHANNEL 2 INPUT connectors:** deliver signal to Channel 2's processor only. It is disconnected when the CROSSOVER ENGAGE switch (7) is in its *in* position. Choose either the XLR or the 1/4" TRS jack, do not use both, they do not sum.
- ④ **CHANNEL 2 / HIGH PASS / COMBINED OUTPUT connectors:** make the signal from Channel 2 available to the outside world and is the high pass portion of the audio when the CROSSOVER ENGAGE switch (7) is in its *in* position. If the SEPARATE / COMBINE switch (8) is in the COMBINE position, this output produces the sum of Channels 1 & 2 and its overall level is controlled by CH 2 OUTPUT LEVEL. Both the XLR and the 1/4" TRS jack may be used if desired.
- ⑤ **SIDE-CHAIN:** Inserting a 1/4" TRS plug into this jack breaks the input signal path to both the Compressor and Gate control circuit. Inserting an equalizer in this loop enables greater compression of boosted equalizer frequencies. The standard convention is used of TIP=SEND & RING=RETURN.
- ⑥ **INPUT GAIN TRIM switch:** In its +4 dBu position, the input gain of the respective Channel is unity. In the -10 dBV position, the input gain is increased by 12 dB (although mathematically suspicious, it really is 12 dB, not 14 dB) to compensate for certain recording devices. This switch must be in the +4 dBu position for front panel calibration accuracy.
- ⑦ **CROSSOVER ENGAGE switch:** In its *in* position, this switch places the low pass portion of the audio signal on the CH 1/LOW OUT jack, and the high pass portion on CH 2/HIGH/COMBINE OUT.
- ⑧ **SEPARATE / OUTPUT COMBINE switch:** In the COMBINE mode, the outputs of Channel 1 and Channel 2 are added together and delivered to the CH 2/HIGH/COMBINE OUT connector. This feature is supplied to allow an input to be split by the crossover, high pass and low pass delivered to separate processor channels, and recombined at the output of the unit. The COMBINE mode has no effect on the output of Channel 1.
- ⑨ **Remote POWER supply input:** The DC 24 is supplied from the factory with a Model RS 1 Remote Power Supply suitable for connection to this input jack. The power requirements of the DC 24 call for an 18-24 volt AC center-tapped transformer only. *This is not a telephone jack. Never use a power supply with your DC 24 other than the one supplied or an exact replacement obtained from Rane Corporation.* Using any other type of supply may damage the unit and void the warranty.
- ⑩ **Chassis ground point:** A #6-32 screw is used for chassis grounding purposes. If after hooking up your system it exhibits excessive hum or buzzing, there is an incompatibility in the grounding configuration between units somewhere. Your mission is to discover how your particular system wants to be grounded. Here are some things to try:
  1. Try combinations of lifting grounds on units that are supplied with ground lift switches or links.
  2. If your equipment is in a rack, verify that all chassis are tied to a good earth ground, either through the line cord ground-pin or the rack screws to another grounded chassis.
  3. Units with outboard power supplies, such as the DC 24, do not ground the chassis through the line cord. Make sure that these units are grounded either to another chassis which is earth grounded, or directly to the grounding screw on an AC outlet cover by means of a wire connected to a screw on the chassis with a star washer to guarantee proper contact. If you are connecting the DC 24 outputs directly to a power amplifier, be sure to connect a ground wire to the amplifier chassis.

Refer to RaneNote 110, "Sound System Interconnection" (supplied in this manual) for further grounding information.

## OPERATING INSTRUCTIONS

Once all of the inputs and outputs are properly connected in accordance with the preceding section, normal operation of the DC 24 should be achievable. If any of the following procedures do not appear to produce the required results, take a step backwards and check your wiring.

### PRE-FLIGHT CHECKLIST

Before proceeding, it's a good idea to turn the control knobs to the following positions:

1. **POWER...off**
2. **EXPAND / GATE THRESHOLD...FULL CCW**
3. **EXPAND / GATE RATIO...FULL CCW**
4. **COMPRESSION THRESHOLD...FULL CCW**
5. **COMPRESSION RATIO...FULL CCW**
6. **LIMIT THRESHOLD...FULL CW**
7. **OUTPUT LEVEL...CENTERED IN ITS DETENT**

Set all pushbuttons on the front and rear to their *out* positions. The **OUTPUTS** slide switch should be in the **SEPARATE** position. The gain **TRIM** switches should be in their **+4 dBu** positions.

### LIMITING

With all of the preceding properly accomplished, turn the **POWER** switch on (be sure your amp is turned down). The DC 24 is now nothing but a unity gain amplifier. Cycling the **BYPASS** switches with audio passing through the unit should yield no difference in level or sound dynamics. The **GAIN REDUCTION** meters should indicate 0 and nothing else. Assuming your input signal has peaks in excess of -20 dBu, you should be able to rotate the **LIMITER THRESHOLD** controls **CCW** and see some gain reduction occur on the meter simultaneously with a randomly illuminating **THRESHOLD LED**. You should begin to hear the difference. Leave these controls at whatever Limit level is appropriate for your application.

### COMPRESSION

To use the Compressor, set the **COMPRESSOR THRESHOLD** for an appropriate level, you should see the associated **LED** illuminate as signal goes above and below this level. The **COMPRESSOR RATIO** control adjusts the gain reduction slope above the level you have set.

### GATE / EXPANDER

The Gate / Expander function works similarly. If the **GATE/EXPANDER THRESHOLD** is still fully **CCW**, rotate the **GATE/EXPANDER RATIO** to its full **CW** position. Stop your audio source and you will see the **GAIN REDUCTION LEDs** drop to the -24 dB position. This indicates that the DC 24 Channel is in the fully gated mode. If you wish to have gating occur at a higher level, rotate the **GATE/EXPANDER THRESHOLD** control **CW** to a higher level. If you wish to create special effects with this gate, you may elect to use a

lower **GATE/EXPANDER RATIO** setting. This inhibits full gating by the amount indicated around the control. Experiment with all the controls to obtain the required results.

### STEREO

When using the DC 24 as a true stereo (a.k.a. stereo; hey, lighten up, it's a joke!) processor, left channel in Channel 1 and right channel through Channel 2, it is a good idea to operate the unit in the **SLAVE** mode to prevent large balance and image shifts. While in the **SLAVE** mode, both channels attenuate by exactly the same amount when the Gate and Compressor work, maintaining the stereo image.

### ATTENTION SHOPPERS

This seems like a good place to throw in a few words of caution. The DC 24 allows a great deal of flexibility. As such, it also allows one to come dangerously close to completely destroying an otherwise respectable audio signal if some thought and care is not put into the operation of the unit. There are combinations of **THRESHOLD** and **RATIO** settings on the Gate, Expander and Limiter which allow each to fight the others and in some cases completely cancel. The same caution applies to any signal processor, such as an equalizer or crossover, however these are a bit more intuitive and less likely to be used in a destructive manner. Just be gentle at first and you should not encounter too much difficulty. If you become overwhelmed, go back to the **PRE-FLIGHT CHECKLIST** for initial control settings and start over.

### BYPASS SWITCHES IN CROSSOVER & COMBINE MODES

**Crossover Mode.** Do not use the **BYPASS** switches when in the **CROSSOVER** mode. Use of **BYPASS** in the crossover mode is potentially destructive since these switches route full bandwidth audio to drivers designed only for a limited frequency range. (CH 2 **BYPASS** is automatically defeated, but Ch. 1 is still active — do not engage the CH 1 **BYPASS** for any reason.)

**Combine Mode.** As more users (particularly bass guitar players) discover new applications for this mode, they want to use **BYPASS** as an aid in optimizing settings. Unfortunately, the **BYPASS** switches do not operate in the **COMBINE** mode; however, a simple trick solves the problem:

1. Permanently engage the CH 1 **BYPASS** switch.
2. Patch **CHANNEL 1 OUTPUT** to **CHANNEL 2 INPUT** using either the 1/4" **TRS** or the **XLR** jacks. Be sure to use 2-conductor shielded cable.
3. The CH 2 **BYPASS** switch now operates in the **COMBINE** mode.

### RESOURCES

For additional explanations, tips and assistance, see *RaneNote 130*, "The DC 24 Users Guide" and *RaneNote 141*, "Good Dynamics Processing." Both are available from the Rane web site.

**RaneNote 110****Sound System  
Interconnection**

- Cause and prevention of ground loops
- Interfacing balanced and unbalanced
- Proper pin connections and wiring
- Chassis ground vs. signal ground
- Ground lift switches

**Rane Technical Staff**

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**INTRODUCTION**

This note, originally written in 1985, continues to be one of our most useful references. It's popularity stems from the continual and perpetual difficulty of hooking up audio equipment without suffering through all sorts of bizarre noises, hums, buzzes, whistles, etc.— not to mention the extreme financial, physical and psychological price. As technology progresses it is inevitable that electronic equipment and its wiring should be subject to constant improvement. Many things *have* improved in the audio industry since 1985, but unfortunately wiring isn't one of them. However, finally the Audio Engineering Society (AES) is trying to do something about it, by working on a recommended practice document for interconnection of pro audio equipment.

Rane's policy is to accommodate rather than dictate. However, this document contains suggestions for external wiring changes that should ideally only be implemented by trained technical personnel. Safety regulations require that all original grounding means provided from the factory be left intact for safe operation. No guarantee of responsibility for incidental or consequential damages can be provided. *(In other words, don't modify cables, or try your own version of grounding unless you really understand exactly what type of output and input you have to connect.)*

## GROUND LOOPS

Almost all cases of noise can be traced directly to ground loops, grounding or lack thereof. It is important to understand the mechanism that causes grounding noise in order to effectively eliminate it. Each component of a sound system produces its own ground internally. This ground is usually called the audio *signal* ground. Connecting devices together with the interconnecting cables can tie the signal grounds of the two units together in one place through the conductors in the cable. Ground loops occur when the grounds of the two units are also tied together in another place: via the third wire in the line cord, by tying the metal chassis together through the rack rails, etc. These situations create a circuit through which current may flow in a closed "loop" from one unit's ground out to a second unit and back to the first. It is not simply the presence of this current that creates the hum—it is when this current flows through a unit's audio signal ground that creates the hum. In fact, even without a ground loop, a little noise current always flows through every interconnecting cable (i.e., it is impossible to eliminate these currents entirely). The mere presence of this ground loop current is no cause for alarm if your system uses properly implemented and *completely* balanced interconnects, which are excellent at rejecting ground loop and other noise currents. Balanced interconnect was developed to be immune to these noise currents, which can never be entirely eliminated. What makes a ground loop current annoying is when the audio signal is affected. Unfortunately, many manufacturers of balanced audio equipment design the

internal grounding system improperly, thus creating balanced equipment that is not immune to the cabling's noise currents. This is one reason for the bad reputation sometimes given to balanced interconnect.

A second reason for balanced interconnect's bad reputation comes from those who think connecting unbalanced equipment into "superior" balanced equipment should improve things. Sorry. Balanced interconnect is not compatible with unbalanced. The small physical nature and short cable runs of completely unbalanced systems (home audio) also contain these ground loop noise currents. However, the currents in unbalanced systems never get large enough to affect the audio to the point where it is a nuisance. Mixing balanced and unbalanced equipment, however, is an entirely different story, since balanced and unbalanced interconnect are truly *not compatible*. The rest of this note shows several recommended implementations for all of these interconnection schemes.

The potential or voltage which pushes these noise currents through the circuit is developed between the independent grounds of the two or more units in the system. The impedance of this circuit is low, and even though the voltage is low, the current is high, thanks to Mr. Ohm, without whose help we wouldn't have these problems. It would take a very high resolution ohm meter to measure the impedance of the steel chassis or the rack rails. We're talking thousandths of an ohm. So trying to measure this stuff won't necessarily help you. We just thought we'd warn you.

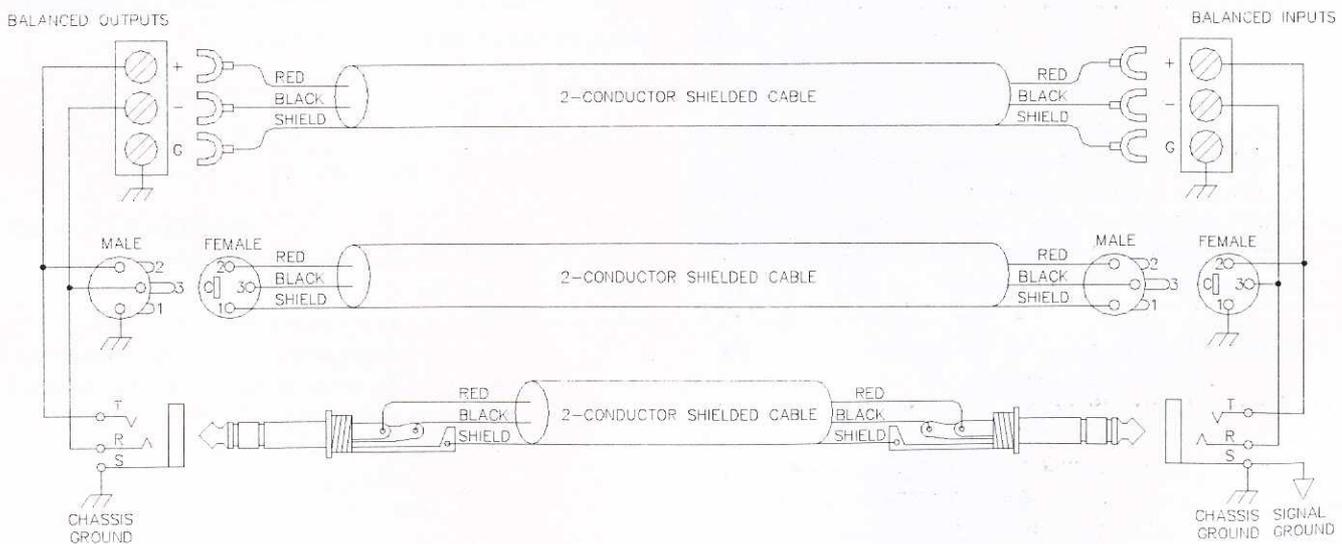


Figure 1a. The right way to do it.

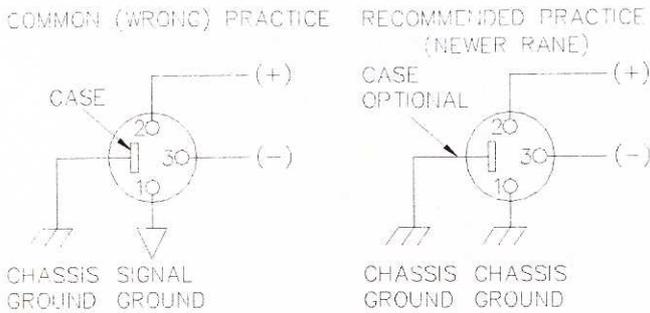


Figure 1b. Recommended practice.

### THE ABSOLUTE BEST RIGHT WAY TO DO IT

Use balanced lines and *tie the cable shield to the metal chassis (right where it enters the chassis) at both ends of the cable.*

A balanced line requires three separate conductors, two of which are signal (+ and -) and one shield (see Fig. 1a). The shield serves to guard the sensitive audio lines from interference. Only by using balanced line interconnects can you *guarantee* (yes, *guarantee*) hum-free results. Always use twisted pair cable. Chassis tying the shield at each end also *guarantees* the best possible protection from RFI [radio frequency interference] and other noises [neon signs, lighting dimmers].

Neil Muncy<sup>1</sup>, an electroacoustic consultant and seasoned veteran of years of successful system design, chairs the AES Standards Committee (SC-05-05) working on this subject. He tirelessly tours the world giving seminars and dispensing information on how to successfully hook-up pro audio equipment<sup>2</sup>. He makes the simple point that it is absurd that you cannot go out and buy pro audio equipment from several different manufacturers, buy standard off-the-shelf cable assemblies, come home, hook it all up and have it work hum and noise free. *Plug and play*. Sadly, almost never is this the case, despite the science and rules of noise-free interconnect known and documented for over 60 years (see References for complete information).

It all boils down to using balanced lines, only balanced lines, and nothing but balanced lines. This is why they were developed. Further, that you *tie the shield to the chassis, at the point it enters the chassis, and at both ends of the cable* (more on 'both ends' later).

Since standard XLR cables come with their shields tied to pin 1 at each end (the shells are not tied, nor need be), this means equipment using 3-pin, XLR-type connectors *must tie pin 1 to the chassis* (usually called chassis ground) — not the audio signal ground as is most common.

Not using *signal ground* is the most radical departure from common pro-audio practice. Not that there is any argument about its validity. There isn't. **This is the right way to do it.** So why doesn't audio equipment come wired this way? Well, some does, and since 1993, more of it does. That's when

Rane started manufacturing some of its products with balanced inputs and outputs tying pin 1 to chassis. So why doesn't everyone do it this way? Because life is messy, some things are hard to change, and there will always be equipment in use that was made before proper grounding practices were in effect.

Unbalanced equipment is another problem: it is everywhere, easily available and inexpensive. All those RCA and 1/4" TS connectors found on consumer equipment; effect-loops and insert-points on consoles; signal processing boxes; semi-pro digital and analog tape recorders; computer cards; mixing consoles; et cetera.

The next several pages give tips on how to successfully address hooking up unbalanced equipment. Unbalanced equipment when "blindly" connected with fully balanced units starts a pattern of hum and undesirable operation, requiring extra measures to correct the situation.

### THE NEXT BEST RIGHT WAY TO DO IT

The quickest, quietest and most foolproof method to connect balanced and unbalanced is to **transformer isolate all unbalanced connections.** See Figure 2.

Many manufacturers provide several tools for this task, including Rane. Consult your audio dealer to explore the options available.

The goal of these adaptors is to allow the use of *standard cables*. With these transformer isolation boxes, modification of cable assemblies is unnecessary. Virtually any two pieces of audio equipment can be successfully interfaced without risk of unwanted hum and noise.

Another way to create the necessary isolation is to use a *direct box*. Originally named for its use to convert the high impedance, high level output of an electric guitar to the low impedance, low level input of a recording console, it allowed the player to plug "directly" into the console. Now this term is commonly used to describe any box used to convert unbalanced lines to balanced lines.

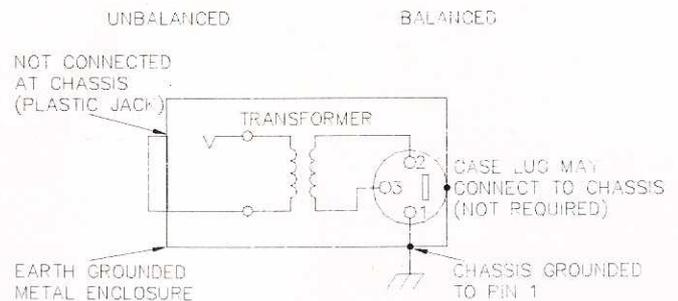


Figure 2. Transformer Isolation

## THE LAST BEST RIGHT WAY TO DO IT

If transformer isolation is not an option, special cable assemblies are a last resort. The key here is to prevent the shield currents from flowing into a unit whose grounding scheme creates ground loops (hum) in the audio path (i.e., most audio equipment).

It is true that connecting both ends of the shield is theoretically the best way to interconnect equipment—though this assumes the interconnected equipment is internally grounded properly. Since most equipment is *not* internally grounded properly, connecting both ends of the shield is not often practiced, since doing so usually creates noisy interconnections.

A common solution to these noisy hum and buzz problems involves disconnecting one end of the shield, even though one can not buy off-the-shelf cables with the shield disconnected at one end. The best end to disconnect is a matter of personal preference and should be religiously obeyed; choose inputs or outputs and always lift the side you choose (our drawings happen to disconnect the input end of the cable—the output of the driving unit). If one end of the shield is disconnected, the noisy hum current stops flowing and away goes the hum—but only at low frequencies. A one-end-only shield connection increases the possibility of high frequency (radio) interference since the shield may act as an antenna. Many reduce this potential RF interference by providing an RF path through a small capacitor (0.1 or 0.01 microfarad ceramic disc) connected from the lifted end of the shield to the chassis. The fact that many modern day installers still follow this one-end-only rule with consistent success indicates this and other acceptable solutions to RF issues exist, though the increasing use of digital and wireless technology greatly increases the possibility of future RF problems.

If you've truly isolated your hum problem to a specific unit, chances are, even though the documentation indicates proper chassis grounded shields, the suspect unit is not internally grounded properly. Here is where special test cable assemblies, shown in Figure 3, really come in handy. These assemblies allow you to connect the shield to chassis ground

at the point of entry, or to pin 1, or to lift one end of the shield. The task becomes more difficult when the unit you've isolated has multiple inputs and outputs. On a suspect unit with multiple cables, try various configurations on each connection to find out if special cable assemblies are needed at more than one point.

See Figure 4 for suggested cable assemblies for your particular interconnection needs. Find the appropriate output configuration (down the left side) and then match this with the correct input configuration (across the top of the page.) Then refer to the following pages for a recommended wiring diagram.

## GROUND LIFTS

Many units come equipped with ground lift switches. In only a few cases can it be shown that a ground lift switch improves ground related noise. (Has a ground lift switch ever *really* worked for you?) In reality, the presence of a ground lift switch greatly reduces a unit's ability to be "properly" grounded and therefore immune to ground loop hums and buzzes. Ground lifts are simply another Band-Aid® to try in case of grounding problems. It is, however, true that an entire system of properly grounded equipment, without ground lift switches, is guaranteed (yes guaranteed) to be hum free. The problem is most equipment is *not* (both internally and externally, AC system wise) grounded properly.

Most units with ground lifts are shipped so the unit is "grounded"—meaning the chassis is connected to audio signal ground. (This should be the best and is the "safest" position for a ground lift switch.) If after hooking up your system it exhibits excessive hum or buzzing, there is an incompatibility somewhere in the system's grounding configuration. In addition to these special cable assemblies that may help, here are some more things to try:

1. Try combinations of lifting grounds on units supplied with lift switches (or links). It is wise to do this with the power off!
2. If you have an entirely balanced system, verify all chassis are tied to a good earth ground, for safety's sake and hum

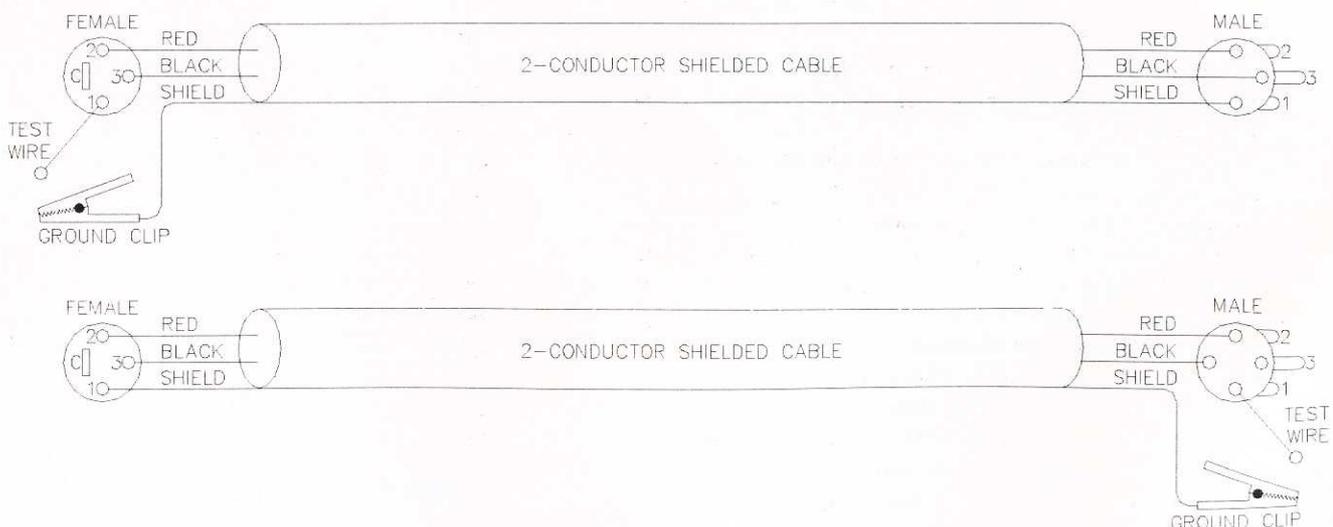


Figure 3. Test cables

protection. Completely unbalanced systems never earth ground anything (except cable TV, often a ground loop source). If you have a mixed balanced and unbalanced system, do yourself a favor and use isolation transformers or, if you're cheap, try the special cable assemblies described here and expect it to take many hours to get things quiet. May The Force be with you.

3. Balanced units with outboard power supplies (wall warts or "bumps" in the line cord) do *not* ground the chassis through the line cord. Make sure such units are solidly grounded by tying the chassis to an earth ground using a star washer for a reliable contact. (Rane always provides this chassis point as an external screw with a toothed washer.) Any device with a 3-prong AC plug, such as an amplifier, may serve as an earth ground point. Rack rails may or may not serve this purpose depending on screw locations and paint jobs.

### FLOATING, PSEUDO, AND QUASI-BALANCING

During inspection, you may run across a 1/4" output called floating unbalanced, sometimes also called pseudo-balanced or quasi-balanced. In this configuration, the sleeve of the output stage is not connected inside the unit and the ring is connected (usually through a small resistor) to the audio signal ground. This allows the tip and ring to "appear" as an equal impedance, not-quite balanced output stage, even though the output circuitry is unbalanced.

Floating unbalanced often works to drive either a balanced or unbalanced input, depending if a TS or TRS standard cable is plugged into it. When it hums, a special cable is required. See drawings #11 and #12, and do not make the cross-coupled modification of tying the ring and sleeve together.

### SUMMARY

If you are unable to do things correctly (i.e. use fully balanced wiring with shields tied to the *chassis* at the point of entry, or transformer isolate all unbalanced signals from balanced signals) then there is no guarantee that a hum free interconnect can be achieved, nor is there a definite scheme that will assure noise free operation in all configurations.

### WINNING THE WIRING WARS

- Use balanced connections whenever possible.
- Transformer isolate all unbalanced connections from balanced connections.
- Use special cable assemblies when unbalanced lines cannot be transformer isolated.
- Any unbalanced cable must be kept under ten feet (three meters) in length. Lengths longer than this will amplify all the nasty side effects of unbalanced circuitry's ground loops.
- When all else fails, digitize everything with fiber optics and enter a whole new realm of problems.

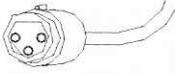
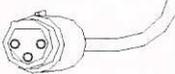
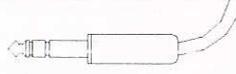
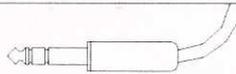
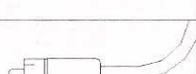
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1. Neil A. Muncy, "Noise Susceptibility in Analog and Digital Signal Processing Systems," presented at the 97th AES Convention of Audio Engineering Society in San Francisco, CA, Nov. 1994.
2. *Grounding, Shielding, and Interconnections in Analog & Digital Signal Processing Systems: Understanding the Basics*; Workshops designed and presented by Neil Muncy and Cal Perkins, at the 97th AES Convention of Audio Engineering Society in San Francisco, CA, Nov. 1994.
3. The entire June 1995 AES Journal, Vol. 43, No. 6, available \$6 members, \$11 nonmembers from the Audio Engineering Society, 60 E. 42nd St., New York, NY, 10165-2520.
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5. Ralph Morrison, *Noise and Other Interfering Signals* (Wiley, New York, 1992).
6. Henry W. Ott, *Noise Reduction Techniques in Electronic Systems*, 2nd Edition (Wiley, New York, 1988).
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8. Stephen R. Macatee, "*Considerations in Grounding and Shielding Audio Devices*," presented at the 97th AES Convention of the Audio Engineering Society in San Francisco, CA, Nov. 1994, preprint 3916.
9. Philip Giddings, "Grounding and Shielding for Sound and Video," *S&VC*, Sept. 20th, 1995.

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# TO INPUT

FROM OUTPUT

| CABLE CONNECTORS   | MALE BALANCED XLR | 1/4" BALANCED TRS | 1/4" UNBALANCED TS | UNBALANCED RCA  |
|--|-------------------|-------------------|--------------------|-----------------|
| <br>FEMALE BALANCED XLR<br>(NOT A TRANSFORMER,<br>NOR A CROSS-COUPLED<br>OUTPUT STAGE)  | 1                 | 2                 | 3 <sub>B</sub>     | 4 <sub>B</sub>  |
| <br>FEMALE BALANCED XLR<br>(EITHER A TRANSFORMER<br>OR A CROSS-COUPLED<br>OUTPUT STAGE) | 1                 | 2                 | 5                  | 6               |
| <br>1/4" BALANCED TRS<br>(NOT A TRANSFORMER,<br>NOR A CROSS-COUPLED<br>OUTPUT STAGE)    | 7                 | 8                 | 9 <sub>B</sub>     | 10 <sub>B</sub> |
| <br>1/4" BALANCED TRS<br>(EITHER A TRANSFORMER<br>OR A CROSS-COUPLED<br>OUTPUT STAGE)  | 7                 | 8                 | 11                 | 12              |
| <br>1/4" FLOATING<br>UNBALANCED TRS<br>(SLEEVE IN UNIT=NC)                            | 21 <sub>A</sub>   | 22 <sub>A</sub>   | 11                 | 12              |
| <br>1/4" UNBALANCED TS  | 13                | 14                | 15 <sub>A</sub>    | 16 <sub>A</sub> |
| <br>UNBALANCED RCA  | 17                | 18                | 19 <sub>A</sub>    | 20 <sub>A</sub> |

**NOTES:**

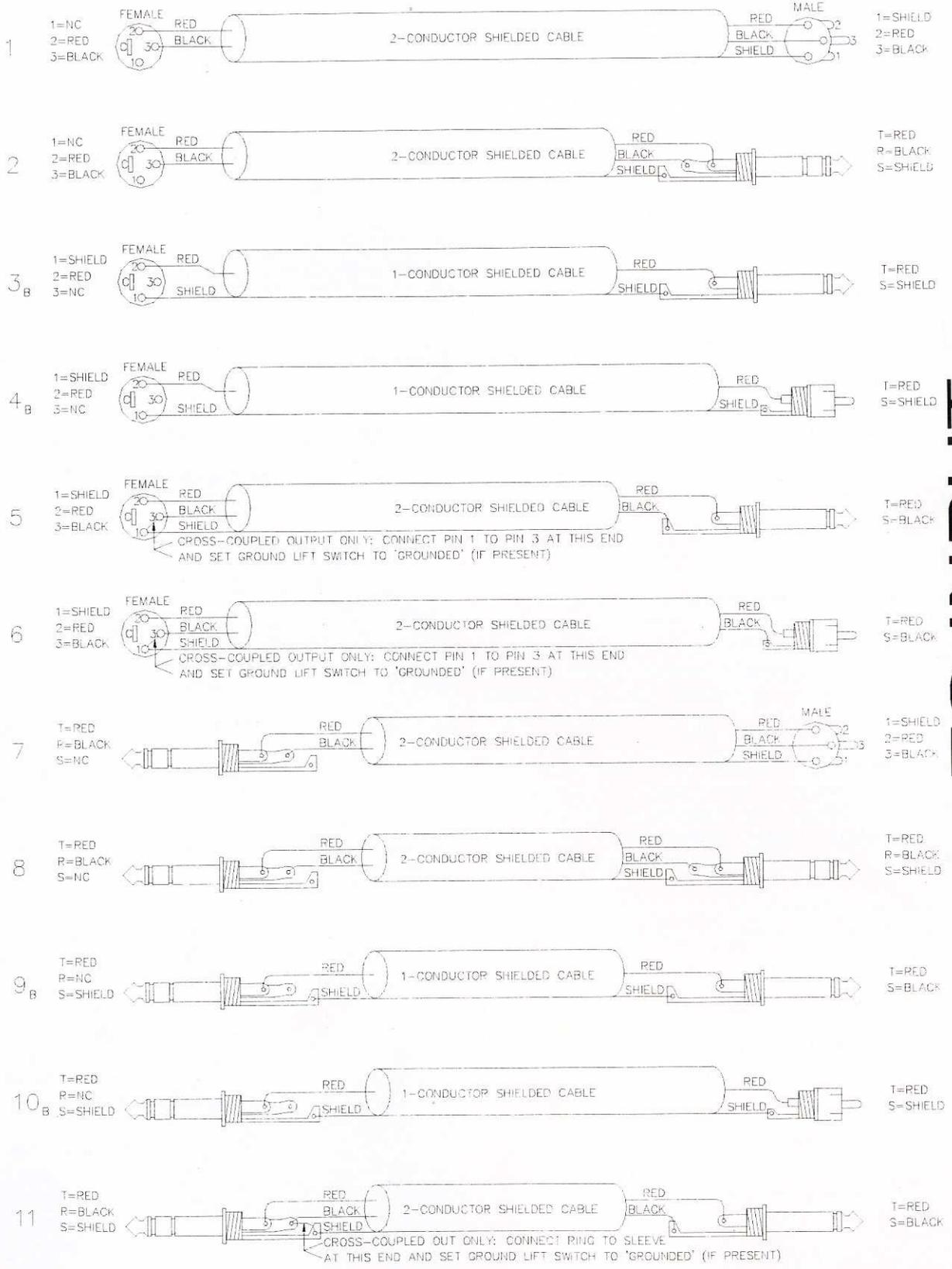
(A) THIS CONFIGURATION USES A STANDARD "OFF THE SHELF" CABLE

(B) THIS CONFIGURATION CAUSES A 6 dB SIGNAL LOSS. COMPENSATE BY "TURNING THE SYSTEM UP" 6 dB

Figure 4. Interconnect chart for locating correct cable assemblies on the following pages.

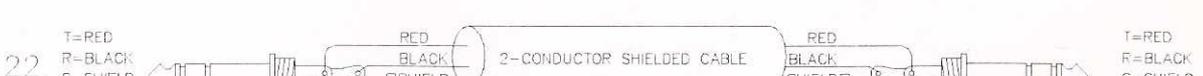
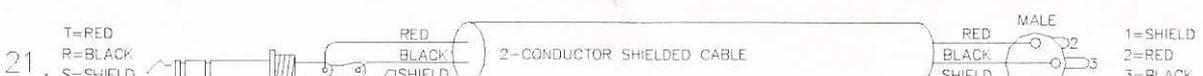
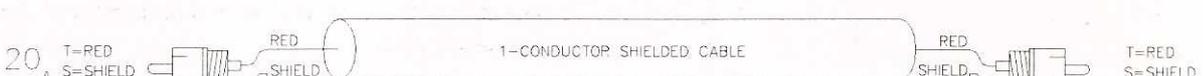
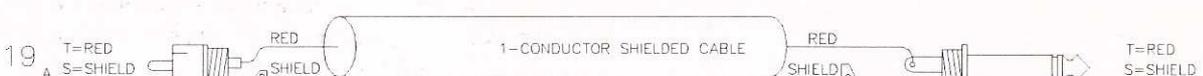
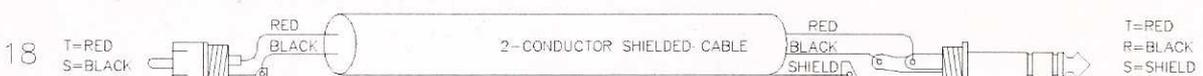
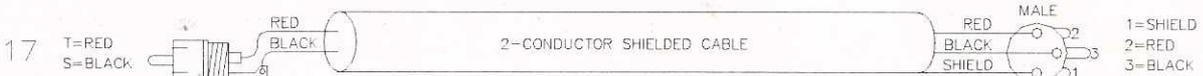
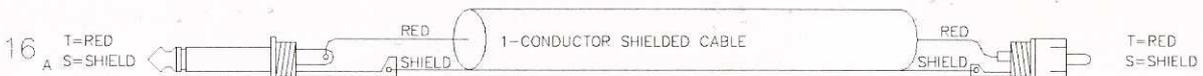
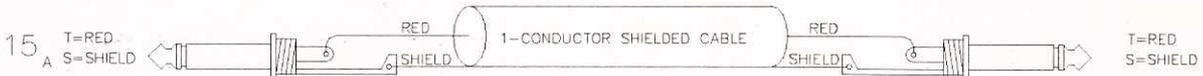
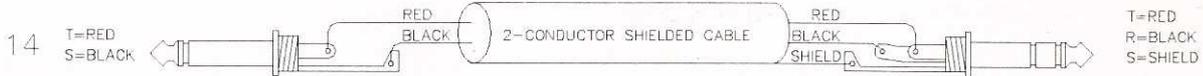
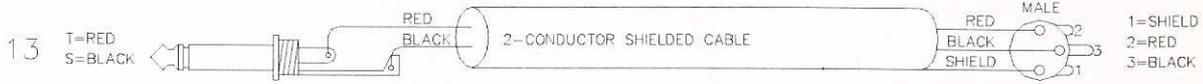
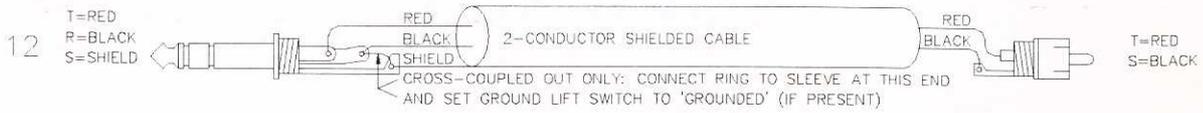
# FROM OUTPUT

# TO INPUT



# FROM OUTPUT

# TO INPUT



**RaneNote 130****Squeeze Me, Stretch Me:  
The DC 24 Users Guide**

- DYNAMICS 101
- THRESHOLD & RATIO CONTROLS
- COMPRESSORS & LIMITERS
- GATES & EXPANDERS
- SPLIT BAND PROCESSING
- GUITAR, BASS & RECORDING

**David Mathew**  
Ashfall Communications

**David Freeman**  
Bassics Magazine

**John Albani**  
Canadian Musician Magazine

**Brent Hurtig**  
EQ Magazine

**Jeff Davies**  
Rane Corporation

**Dennis Bohn**  
Rane Corporation

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**INTRODUCTION**

Compressors, expanders, and their cohorts – limiters and gates, are all in the business of automatically controlling the volume, or dynamics of sound. Lumped together they can be called dynamic controllers, which would also have to include your hand on the fader and the fat man dancing in front of the midrange cabinet.

Used wisely, often in conjunction with each other or with equalization or filtering, dynamic controllers can improve the intelligibility of voice and the subjective effect of music. But in the wrong hands they can sound terrible, and compressors are the worst offenders.

Our goal here is to de-mystify dynamic controllers as best we can within the limitations of printed media. By understanding a given tool's strengths and weaknesses, you can put it to its best use.

**Roger Nichols** - "I have used the DC 24 on every album project I have done since I've had it". He has had a DC 24 since 1988. Projects include mixdown on Riki Lee Jones *Flying Cowboys*, recording and mixdown on Donald Fagens *Kamakiriad*, and numerous others.

**Walter Becker** - "The DC 24 is great for bass and guitar. I suggest you check it out". Walter is a member of the popular group, *Steely Dan*.

## DYNAMICS 101: A PRIMER

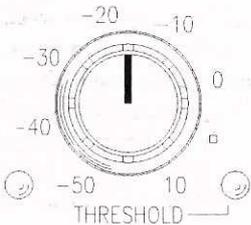
Let's start with what a dynamic controller actually does. No matter how you cut it, these are electronic volume controls. It is a hand on a knob, turning the volume down and turning it up again. The hand is really quick and really accurate, but it's just turning a volume control.

### SIGNAL CHAIN

Conceptually, dynamic controllers have two internal paths, the signal and the side chains. The signal chain is the path the main signal takes through the unit: through the input circuits, the gain control device and then through the output circuits. The signal chain goes through the "volume control" in the "hand on a knob" analogy.

### SIDE CHAIN

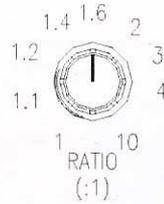
The side chain is the hand which turns the knob. Side chain circuitry examines the input signal and issues a control voltage to adjust the amplification of the signal chain. There are a number of parameters governing side chain activity, but the four most commonly discussed are threshold, ratio (or slope), attack time and release time. Some dynamic controllers offer front-panel adjustment of all these parameters, while others have one or more preset at an optimum setting for the application.



### THRESHOLD

The threshold, like crossing through a doorway, is the point at which gain adjustment begins. When the input signal is below the threshold, a dynamic controller should be like a straight wire. Above, the side chain asserts itself and turns the volume down.

### RATIO



Once the threshold is exceeded, just how far the volume goes down depends on the ratio (or slope) setting. An ordinary preamp or a straight wire has a ratio of 1:1, that is, the output level tracks the input level perfectly. A 2dB change at the input produces a 2dB change at the output.

A severe ratio is perhaps 8:1 or 10:1. For a 10:1 ratio, a 10 dB blast at the input would rise only 1 dB at the output - heavy compression. Kinder, gentler ratios are in the 2:1 to 3:1 range.

### ATTACK TIME

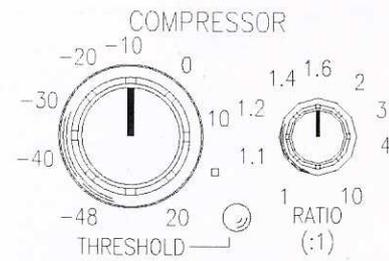
Attack time is the time which passes between the moment the input signal exceeds the threshold and the moment that the gain is actually reduced. Attack times generally range between 1ms and 30ms.

### RELEASE TIME

Release time is the time which passes between the moment the input signal drops below the threshold and the moment that the gain is restored. Typical release times are between .1 seconds and 4 seconds.

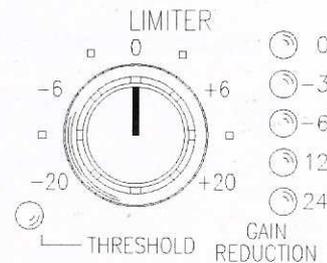
Some of the oldest compressors were called levelers, which are becoming popular again. They had very slow attack times and very long release times to provide volume adjustment of overall program level for broadcast. If you shouted repeatedly, the level would slowly fall off for about 30 seconds, then it would take another minute or so to recover.

## COMPRESSORS



A compressor, when the input signal reaches the level set by the Threshold control, begins turning down the signal by an amount set by the Ratio control. Most modern compressors make the loud signals quieter, but do not make the quiet parts louder. (However, by keeping the loud signals under control, you can turn up the output level which will make the quiet parts louder along with the rest of the signal.) Some compressor designs actually do raise quiet signals below the threshold. These designs might be called "upward expanders".

### LIMITERS



A limiter is a special form of compressor set up especially to reduce peaks for overload protection. In other words, it is a compressor with a maximum ratio. A compressor is usually set up to change the dynamics for purposes of aesthetics, intelligibility, or recording or broadcast limitations. Once the threshold of a limiter is reached, no more signal is allowed through. A limiter has a relatively high threshold, very fast attack and release times and a very high ratio, approaching infinity:1.

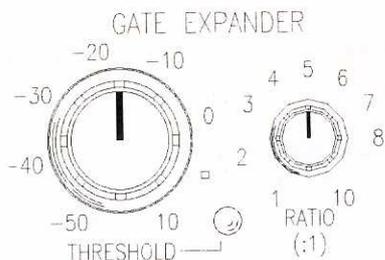
### EXPANDERS

An expander is a compressor running in reverse. Above the threshold, a compressor reduces the gain; below the threshold an expander reduces the gain. A compressor keeps the loud parts from getting too loud, an expander makes the quiet parts quieter.

## GATES

A gate is an expander with the ratio turned up. With the proper settings (low threshold and a high ratio), a gate can be applied to remove noise between louder sounds, and is often called a noise gate for the way it can lock out background noise.

## GATE / EXPANDERS



A low ratio acts as an expander that turns quieter signals down, while a high ratio acts as a gate that shuts signals off.

## SIDE CHAIN EXTRA #1: SEND/RETURN

The gain control voltage is derived from the side chain audio. If you were to put a signal with treble boost into the side chain audio, it would not effect the treble in the main signal path, but it would cause the high frequencies to cross the threshold sooner or more often. Large peaks of treble could be set to cause heavy compression with virtually no compression at other times. What we've just designed here is the basic de-esser, a circuit to remove excess sibilance. With a bass boost you can make a de-thumper and with a midrange boost a de-nasaler. Most compressors have a send and return available in a side chain loop to patch in an equalizer for these purposes.

## SIDE CHAIN EXTRA #2: SLAVE

Many compressors and expanders make the side chain control voltage available to connect to a neighboring unit, or to tie internal channels together. This is called slaving or linking the compressors, and it causes the units to compress simultaneously when only one has an input over the threshold. This feature is normally used to preserve stable stereo imaging, or to preserve spectral balance when the compressors are used in the high and low frequency ranges of a mono signal.

## THIS IS ALL VERY INTERESTING. SO WHAT'S THE PROBLEM?

The problem is that heavy compression (low threshold and a high ratio), almost always has nasty side effects. In the first place, the timbre of the sound itself changes; it becomes "hard" and "closed" and not nearly as sweet and open as the sounds you envisioned when you got into this business. Second, attack times optimized for pleasant compression will not track initial transients quickly enough, and many instruments audibly suffer. Third, heavy compression will usually be accompanied by "breathing," i.e., the background noise rises way out of proportion to the foreground sound as the compressor releases. Bottom line: it just doesn't sound good. Take anybody's compressor, run just about any sound through it, compress it severely and run the results on Family Feud: survey says, 89% of the audience won't like it.

## SO WHAT'S THE SOLUTION?

Many designs have appeared throughout the years to produce gentle, smooth, natural-sounding compression. They include tubes, FETs, VCAs, soft-knee compressors, electro-optical attenuators, and self-adjusting attack and release times. Today, some digital workstations compress without snipping transients, by looking ahead into the digital future. Is that cheating or what? So what has Rane done to make its compressors sound so great?

An independent panel of judges has studied Rane's compressor designs and unanimously decided there has been no cheating. Rane has combined a number of perfectly even handed, meat-and-potatoes ideas to make its compressors so capable and transparent that we just *seem* like we're not being fair.

## IDEA NUMBER ONE

Use self-adjusting attack and release times. The compressor and expander sections in the DC 24 change attack and release times automatically to suit the program material by using dedicated RMS-sensing ICs in the side chain. If the input is predominantly low-frequency, the times are made more gradual and slowed. If a quick transient comes flashing down the wires, the times are tightened to deal with it. Our experience has shown that attack and release controls, when present, are confusing and easy to misalign.

## IDEA NUMBER TWO

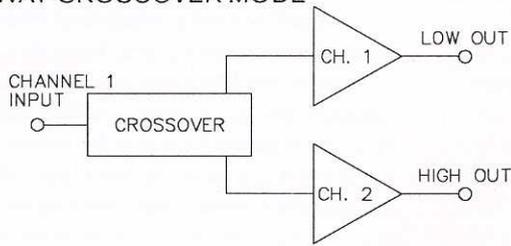
Combine an expander/gate function with the compressor. The expander/gate, the compressor (and the limiter: see Idea Number Three) in the DC 24 can be used independently, but a big reason they are together is to share the work of clean compression. An expanded or gated source of sound exhibits less "breathing" when compressed. Instead of looking for another patch cord when you realize you need a bit of gating, you just turn a knob.

## IDEA NUMBER THREE

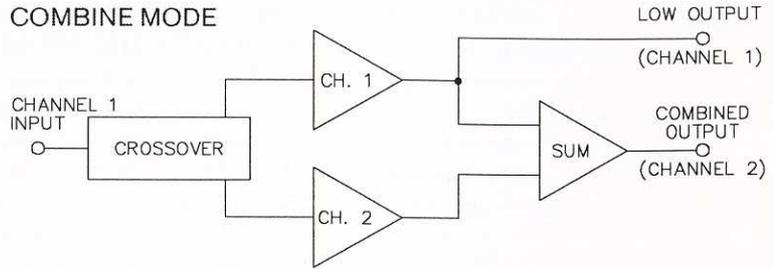
Combine a peak limiter function with the compressor. Tracking with this idea of burden-sharing, Rane has put a peak limiter in the same path as the expander and the compressor in the DC 24. With a limiter right there, you won't be asking the compressor to clamp the wild excursions. The limiter, with auto-attack, auto-release and adjustable threshold optimized, will play level police while the compressor persuades more gently.

Rane designed a patented servo-locked limiting circuit, which places the limiter within a servo loop and effectively stops peaks from exceeding the threshold. The attack time varies with the source material, but is never allowed to produce diode-like hard clipping.

## 2-WAY CROSSOVER MODE



## COMBINE MODE



## REALLY GREAT IDEA NUMBER FOUR, WHICH DESERVES ITS OWN SECTION

Here's the special twist in the DC 24: the two sections, fabulous as they are, can also be assigned to *different frequency ranges* of the same channel of sound. This is not a new idea, but it's a great idea. In the past, the difficulty has been that split-band compression has required a lot of equipment: at least two compressors and a set of bandpass filters per channel, or a very expensive difficult-to-set large unit. What the DC 24 offers is not just innovative engineering but a lot of powerful, interactive functions crammed into one rack space.

## SPLIT-BAND DYNAMIC PROCESSING

We haven't talked much about split-band processing, but it's one of the easiest ways to compress transparently. Broadcast stations have used split-band compression for years, often dividing the spectrum into four or five bands. When it's done right, the radio station sounds great: loud, present, with no squashing or pumping at all.

The great Dolby noise reduction

systems, from Dolby A all the way through B, C, S and SR, all use some variation on compression, expansion and band-splitting. Dolby's goal has always been maintenance of the purity of sound, with no artifacts of the processing. It works.

Split-band compression works well for several reasons: You can optimize each set of dynamic processors (the compressor, expander and limiter) to a particular range of audio. That is, the ratio and threshold controls can be suited to each part of the spectrum.

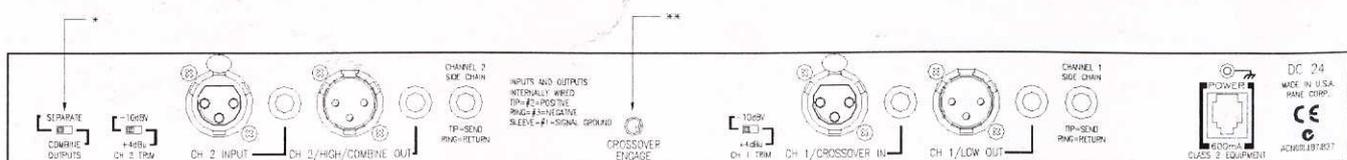
You can decide to process different ranges of an instrument differently. You could use no compression at all on the low end of a bass, with heavy compression on the top end to put the string slaps in balance with the bottom. Or you could tighten the boomy bottom up with compression but leave the top less controlled for that open feeling.

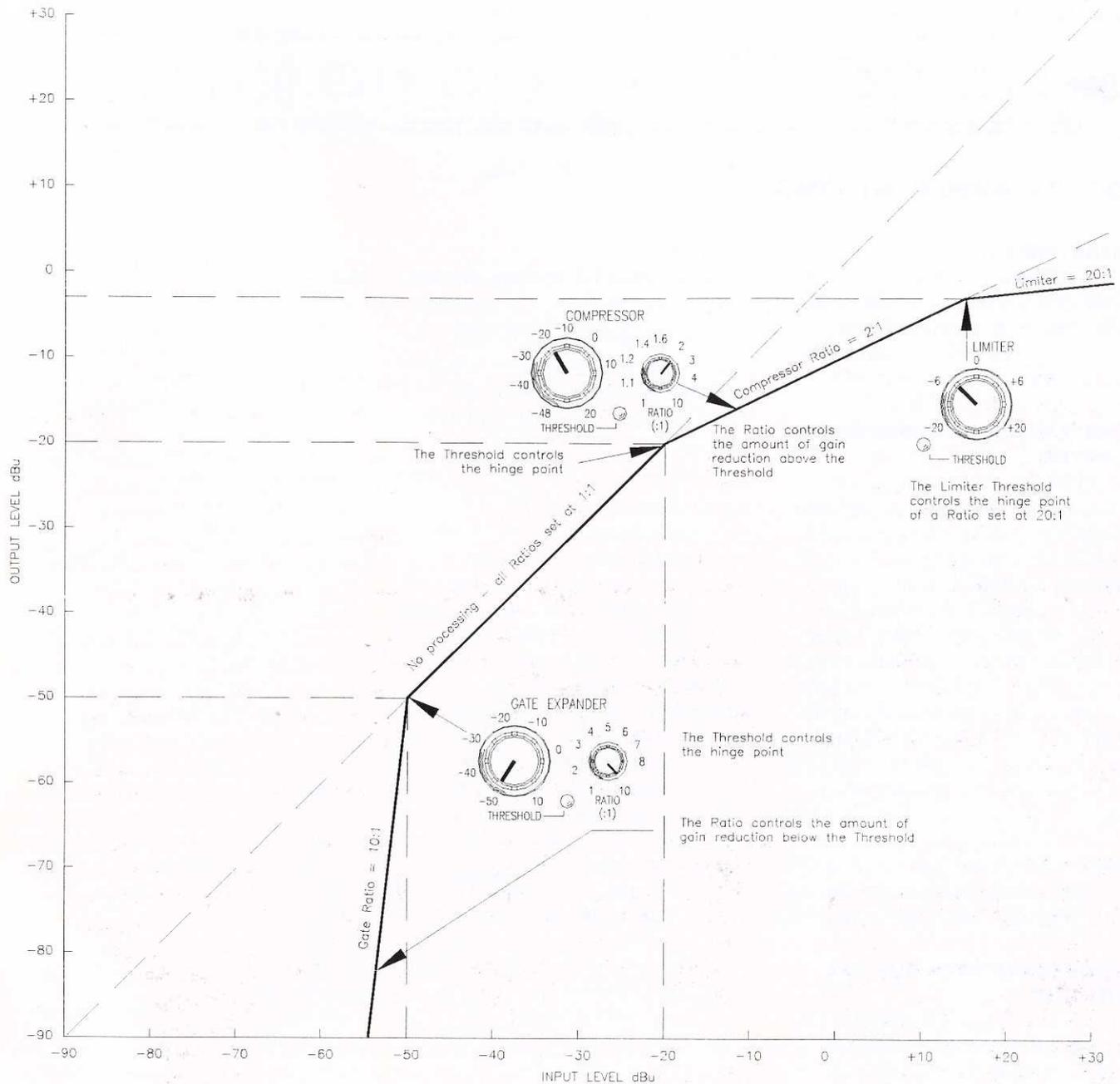
Any massive anomaly like a low frequency breath noise for example, only triggers gain reduction within its range, leaving the desired vocal unaltered. And the decidedly unmusical phenomenon of a popped 'P' sucking the overall level back 10dB is a thing of the past.

## VISUALIZING ALL THIS

The block diagrams below show a couple of different configurations, depending on the positions of the Crossover / Dual / Combine switches that truly make the DC 24 a multi-function unit. It can be a two way crossover, with independent processing on the low and high outputs. The outputs can be summed with the SEPARATE/COMBINE switch\*, and the CROSSOVER can be switched in\*\* (see rear panel below), so that processing the low and highs separately can take place in a mono or send/return application. Even though the outputs are summed at Channel 2's output, Channel 1 is still outputting the lows which might be valuable to a bass player running a full range along with a bass bin (see the block diagrams above).

The big chart on the facing page shows how the gate/expander, compressor, and limiter all can work together on the same program material in a single channel. The vertical axis is the output level, and the horizontal axis is the input level. When all Ratios are set at 1:1, the input and output of the circuit are the same as illustrated by the straight



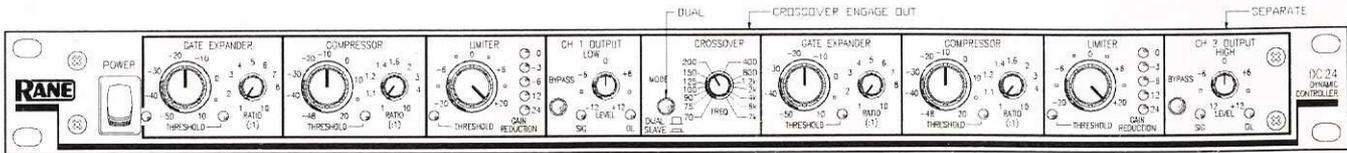


diagonal line running at 45° across the graph. Each of the Threshold controls acts like a “hinge point”, activating gain reduction only when the input signal reaches the level set by this control. The Ratio controls how much of an “angle” the hinge will bend, or more realistically how much gain reduction will occur once the threshold is reached. Graphically, the ratio can swing this

hinge from 45° (no processing) to almost 90° (full ratio). It is also possible, by adjusting the Thresholds, to have each of these circuits overlap and interact with each other to develop a dynamic curve. The solid black line shows the curve produced when the controls are set as shown.

In this example, the gate/expander circuit works on the quiet parts, and the

compressor and limiter work on the louder parts. The gate/expander can range from just turning down the quiet parts a little to a lot. The compressor and limiter are a lot more flexible when used separately at different thresholds, even though they have the same job of keeping the loud stuff under control. Got it?



## "Straight Wire" Setup

### DC 24 APPLICATIONS

#### STARTING OUT

Sometimes it's necessary to start from scratch. The drawing above shows where the knobs should be for *no* processing. Then you can adjust each section one at a time.

#### TWO CHANNEL COMPRESSOR/LIMITER

In this case, the audio path on channel 1 is completely separate from channel 2, allowing you to use it as a stereo unit or for doing two completely different processes to two completely different signals. For stereo use, the front panel has a "Dual/Slave" mode switch that allows you to slave channel 2 to channel 1. This assures that both signals are affected identically. In this application, the crossover is disengaged (this button is located in the middle of the rear panel.) The "Separate/Combine" switch on the rear panel should be in the "Separate" mode. Set the rear panel "-10/+4" switches accordingly, depending on whether you are running your system at -10dBV or +4dBu levels.

#### CROSSOVER WITH BUILT-IN LIMITING

Let's say that you want to run a bi-amped system and process the low end a little differently than the high end. This is a handy way of saving your woofers from over-excursion. In this application the crossover is engaged and set at the recommended crossover point for your speakers, let's just say 1.2k for the sake of example. In this instance the Separate/Combine switch on the far left of the rear panel is set on Separate. Your input would connect to the Channel 1 input jack. This gives you a separate output on Channel 1 (signals below 1.2k, the "lows") and everything from 1.2k and above on Channel 2 (the "highs"). This setup allows you to better contain the low end without unnecessarily limiting the high end. A crossover and a processor all in one rack space!

#### GUITAR

**John Albani** (Canadian Musician Magazine)- "By now, I'm sure that you have heard that a low stage volume is essential to your sound man getting a better house mix. Well, here are a few suggestions on how to achieve a lower volume without sounding like you're playing out of a transistor radio.

"Marshalls and other 4 x 12 cabinets give a great 'chunky' sound, but it is also accompanied by an annoying 'woofing' on the lower end. This stereo compressor has the unique feature of becoming a two-way crossover with independent low end and high end compressors. With this I was able to achieve what was previously only possible with the dynamics section of the SSL console that was used for my guitar sounds on the Lee Aaron "Bodyrock" album. Take the preamp output of the loop into the DC 24 Channel 1 Input. The Channel 2 Output should return to the main amp input of the effects loop or the power amp (via your effects). Set the switches to Dual / Crossover / Combine. Now you can set a crossover point on the front panel (try around 400 Hz) and compress the bottom end at a 10:1 ratio. While chugging on a chord where you notice a lot of woofing, set the gain reduction with the Threshold control to read 6dB. When you hit an open chord, there should be no gain reduction. If there is, back off on the Threshold, not on the Ratio. Now compress the top end between a 1.5:1 to 2:1 ratio, with 3dB gain reduction when an open chord is hit, to give your sound a lot more attack. Also, no matter where you play on the neck, the bottom end of the sound will be even, without woofing, giving your overall tone punch and clarity.

"Warning: Do not over compress the top end or the pick attack will be slurred. If you want to hear more attack,

turn up the top end Level of the DC 24 after setting the above-mentioned compression for the top end.

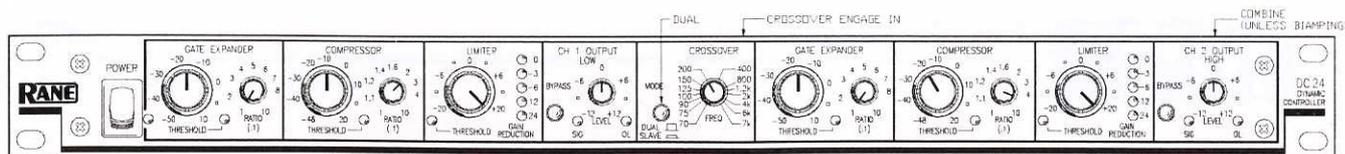
"Right now you are 99% on your way to retaining your sound or bettering it, without blasting everyone to Palookaville, or deafening your sound man.

"On stage you must work within the tonal range of your instrument. I hear guitarists with huge sounds that are great until the bass player fires up. He can't hear because the bottom from the 4 x 12s is blurring out his bottom end. So you end up in a volume war, which puts you out of the front mix. Try this: Once you have the sound you like, back off on the bottom Level control of the DC 24. Your bass player is already operating in that tonal range and you won't miss the sub lows when he's playing with you anyway."

#### BASS

Now for you bass guitar players out there...How many times have you been yanked out of the mix by your soundman because you're overdriving the system? You'd love to be able to keep the high-end attack without booming on the low end. Well, try this. Set the switches to Crossover *in*, Separate/Combine to Combine, and Dual Mode on the front panel. Now, plug into Channel 1 from your preamp output, and come out of Channel 2 into your amp. What you have done is split your mono signal, with a crossover point, then you've run it through separate processors and combined the signal back together on the Output of Channel 2.

Where does the unit go in the signal chain? Well, that depends on how you want it to function. If it's a comp/limiter for the input signal, it would go after the bass (if the bass has a line-level output) and before the preamp. If it's to function as a limiter to protect the speakers in the bass rig, it would go



## Bass Guitar Setup

after the preamp and before the power amp. Another method is to insert the unit in the effect loop of the preamp. This allows the bass signal to be affected by the pre-amp first, then the comp/limiter, and then sent to the power amp. This can be desirable with tube pre-amps.

This unit can also be used for biamp rigs. For this, it is placed in the signal chain after the preamp and before the power amps. The output from the preamp is the signal that is processed and split at the selected crossover point. For biamp purposes, the Combine/Separate switch should be in the Separate position. Channel 1 processes the lows and channel 2 processes the highs. The low and high outputs are independent and correspond to Channels 1 and 2.

The DC 24 has two great advantages over other compressors—the crossover and the dual channels. It gives you complete control of the signal and processing of it. This is something that wasn't available before in a single unit. One stereo or two mono comp/limiters and one crossover would be required to do what the DC 24 does in a single rack space. This unit solves many compressor blues. For more attack, you can turn up the Level on the top end. Notice that when you stop playing, that amp buzz and hiss goes away. Nice, huh?

**Dave Freeman** (Bassics Magazine)-  
“I tested this unit in the combine mode with the crossover set at 200Hz. I used my 4 string Music Man bass, famous for its ear splitting high end, as test in different channel settings. I set Channel 1 (low end) for mild compression at 2:1 with the Threshold at -10dB. I set Channel 2 (high end) for heavy compression at 6:1, and the Threshold at -20dB. I turned the volume and the treble controls on the bass on full, and slapped

and popped like a madman. So what happened? Well, the high end was compressed down to the low end level. The sound was balanced and didn't have a compressed tone. I could slap away 'til my fingers went numb without having the comp/limiter clamp down on the entire signal. Impressive results!

“I then tested the unit with my 5 string Ken Smith bass. I set the lows for mild compression at 2:1 at -20dB Threshold. I set the high end for the same compression but with the Threshold at -10dB. I wanted just a bit on the bottom for the low B string and less processing on the highs. I slapped and popped on all the strings including the low B. The result was slight processing on the lows which tightened the bottom, but didn't make it *sound* controlled or processed. The highs had subtle compression that sounded natural, unlike others that 'breathe' when compressing.”

## RECORDING

Use it on bass guitar, piano, drums, vocals—anywhere you've used a compressor/limiter before. The DC 24 gives you more control and a less tortured sound. In fact, split-band processing works so well that a DC 24 sounds good compressing an entire mix (two required for stereo in split-band mode).

Of special interest are instruments which have large level differences in their different tonal ranges. String pops on a bass are one, but flute is another. The higher tones require more breath and are much louder than the lower. Another good application would be a drum mix or submix. A split-band compressor does a better job of smoothing the performance out.

**Roger Nichols** (Engineer)-

He uses the DC 24 primarily on bass

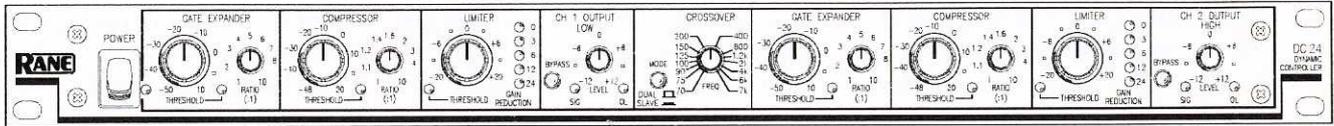
and guitar. He sets the Crossover at 100Hz, the Gates and Compressors to 1:1, and engages the Combine and Dual Mode switches. This gives him separate Limiters to control the high and low peaks separately on a mono signal.

**Brent Hurtig** (EQ Magazine)-

“In the studio, the crossover has some different applications. With Combine selected and the Crossover engaged, a signal entering Channel 1 is split into two bands. These two bands again may receive separate processing. What's different here, though, is that the two bands' signals are merged at the Channel 2 Output. This little exercise allows you to apply different amounts of compression and limiting to the low and high ends of a piano. Or let's say the saxophonist sounds great, but every time she hits the high C she pins the meters: Just the high end of the sax could be limited. Very clever.

“You also can use the Separate mode in the studio. With this setting, the crossover acts like a low pass filter to signals in Channel 1, and like a high pass filter to signals in Channel 2. We found some great sounding guitar, vocal, and keyboard tones using the DC 24 in this equalizer-like manner.”

Digital Recording: Use it to compress an extremely wide dynamic range into a signal that won't go into digital overload, i.e. clipping. The limiter is the primary circuit here to keep things under control, but a little compression with its threshold set just under the limiter threshold setting will help keep the limiting even more subtle. Also, the gate can be set just above the noise floor with a low threshold and high ratio to remove mixer or tape hiss between cuts. To control a stereo mix, the switches should be set to Normal / Separate / Slave.



## General Description

The Rane Model DC 24 Dynamic Controller is a two channel Compressor, Limiter, Expander Gate system with very unusual attributes. The DC 24 offers unprecedented control of its operating parameters as well as a built-in 24 dB/octave Linkwitz-Riley Crossover which gives it very impressive capabilities.

Total freedom from control interaction highlight the DC 24 as well as the availability of separate Compressor and Limiter controls. The Compressor offers control over both Ratio and Threshold, while the Limiter allows setting a separate Threshold. In doing this, the DC 24 allows the operator to create a smooth transition between subtle compression over a wide dynamic range and peak-stop limiting at the sound system's highest allowable level. If that's not enough, the DC 24 also offers independent Expander/Gate Ratio and Threshold controls. This third level of signal manipulation makes the DC 24 a most useful and revolutionary device.

Attack and release times are automatic and program dependent. This simplifies use of the DC 24, as these subtle controls can confuse most users. History has proven that experienced compressor users rarely miss these controls after using a DC 24.

The internal Crossover allows the DC 24 to operate as a two-way speaker dividing network along with all of the dynamic characteristics of a fully featured Compressor Limiter. In addition to this application, the DC 24 supplies the necessary circuitry to allow the unit to divide a single channel of audio information in two separate frequency ranges and to then recombine the program material into one Channel. Using the DC 24 in this way eliminates the pumping and breathing associated with compression and limiting when only one Channel is used to cover the entire audio spectrum.

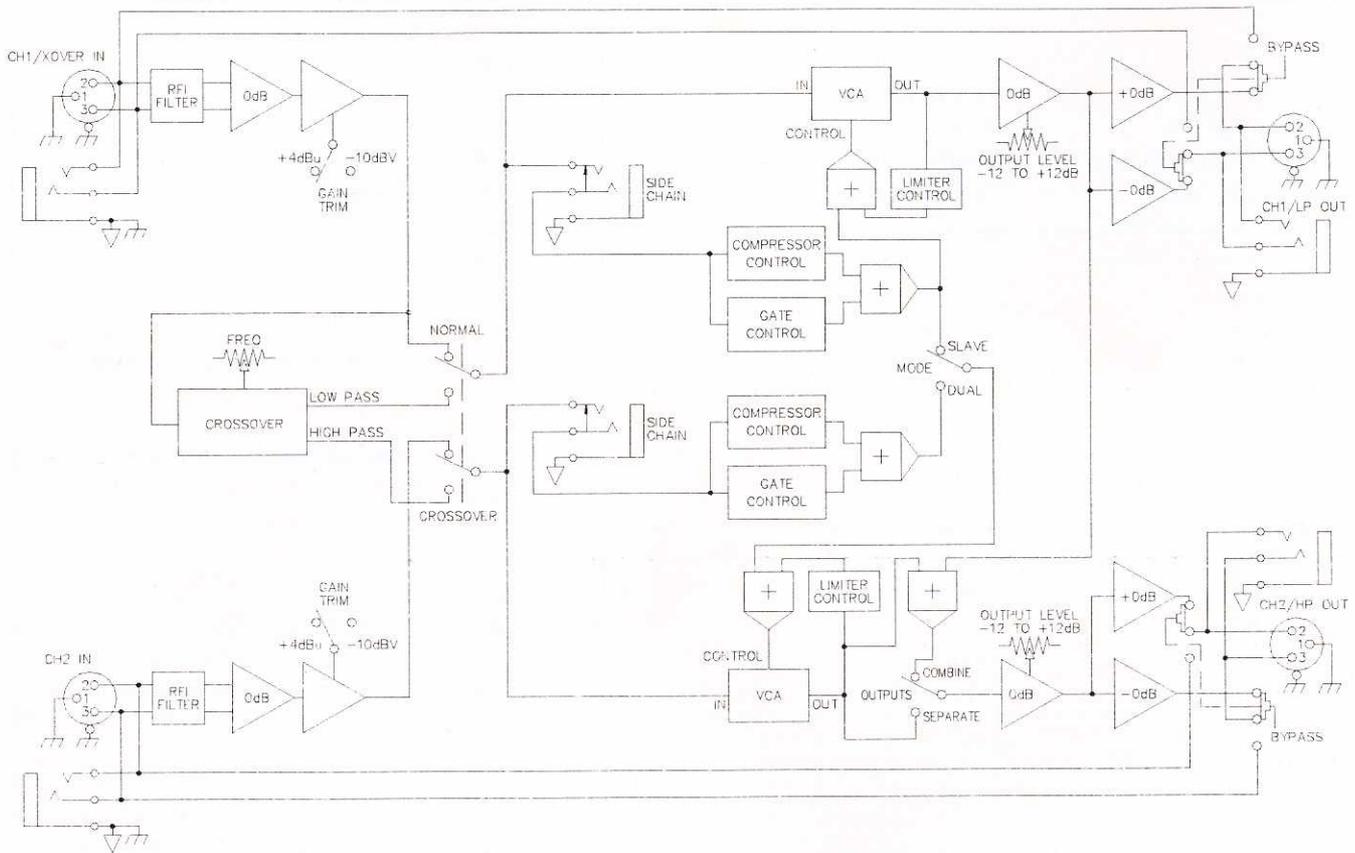
Refer to RaneNote 130 "The DC 24 User's Guide" for an easy-to-understand guide of operation and applications.

## Features

- Compression & Expander/Gate Ratio & Threshold Controls
- Limiter Threshold Controls
- Program Dependent Attack & Release
- Linkwitz-Riley Crossover with 24 dB per Octave Slopes
- Low-High Crossover Mode (1 In/2 Out)
- Bandsplit Combine Mode (1 In/1 Out)
- Stereo/Dual Modes (2 In/2 Out)
- Side Chain Insert Jacks
- Balanced XLR & 1/4" TRS Connectors
- -10 dBV / +4 dBu Gain Switch
- UL/CSA Remote Power Supply (120 VAC)
- CE (Low Voltage & EMC) Remote Power Supply (230 VAC)



| Parameter  | Specification                 | Limit   | Units | Conditions/Comments  |
|--|-------------------------------|---------|-------|--|
| Compressor   |                               |         |       |  |
| .....Threshold Range   | -50 to +20                    | 5       | dB    |  |
| .....Ratio Range   | 1:1 to 10:1                   | 10      | %     |  |
| Expander / Gate  |                               |         |       |  |
| .....Threshold Range   | -50 to +10                    | 5       | dB    |  |
| .....Ratio Range   | 1:1 to 20:1                   | 10      | %     |  |
| Limiter  |                               |         |       |  |
| .....Threshold Range   | -20 to +20                    | 2       | dB    |  |
| Crossover  |                               |         |       |  |
| .....Type  | Linkwitz-Riley 4th-Order      |         |       | 24 dB per octave slopes  |
| .....Range   | 70 Hz to 7 kHz                | 5       | %     | 41-detent continuously variable pot                                    |
| Inputs: Type   | Active Balanced / Unbalanced  |         |       |  |
| .....Connectors  | XLR & + 1/4" TRS              |         |       |  |
| .....Impedance   | 20k                           | 1%      | ohms  |  |
| .....Maximum Level   | +20                           | 1       | dBu   |  |
| Outputs: Type  | Active Balanced               |         |       |  |
| .....Connectors  | XLR & + 1/4" TRS              |         |       |  |
| .....Impedance   | 100                           | 1%      | ohms  | Each output  |
| .....Maximum Level   | +26                           | 1       | dBu   | 2k ohms or greater   |
|  | +20                           | 1       | dBu   | 600 ohms or greater  |
| Overall Gain Range   | -12 to +12                    | ±1      | dB    | Center detent unity gain   |
| RFI Filters  | Yes                           |         |       |  |
| Passive Bypass Switch  | Yes                           |         |       |  |
| LED Thresholds: Overload   | +22                           | 1       | dBu   | Output or any internal level   |
| .....Signal Present  | -40                           | 3       | dBu   | Input Level  |
| Frequency Response   | 20 Hz-20 kHz                  | +0/- .5 | dB    |  |
| THD+Noise  | 0.05                          | .01     | %     | +4 dBu, 1 kHz  |
| IM Distortion (SMPTE)  | 0.1                           | .01     | %     | 60 Hz / 7 kHz, 4:1, +4 dBu   |
| Signal-to-Noise Ratio  | 108                           | 2       | dB    | Unity Gain re +20 dBu, 20 kHz BW                                       |
|  | 92                            | 2       | dB    | Unity Gain re +4 dBu, 20 kHz BW  |
| Unit: Agency Listing   |                               |         |       |  |
| .....120 VAC model   | Class 2 Equipment<br>UL & CSA |         |       | National Electrical Code<br>Exempt Class 2 equipment                   |
| .....230 VAC model   | CE-EMC<br>CE-Safety           |         |       | EMC directive 89/336/EEC<br>Exempt per Art. 1, LVD 73/23/EEC           |
| Power Supply: Agency Listing   |                               |         |       |  |
| .....120 VAC model   | UL<br>CSA                     |         |       | Class 2 Equipment<br>File no. E88261                                   |
| .....230 VAC model   | CE-EMC<br>CE-Safety           |         |       | File no. LR58948<br>EMC directive 89/336/EEC<br>LV directive 73/23/EEC |
| .....100 VAC model   | Built to JIS                  |         |       | Japan only   |
| Power Supply Requirement   | 18 VAC w/center tap           | 0.1     | Vrms  |  |
| Maximum Current  | 600                           |         | mA    | RMS current from remote supply   |
| Unit: Construction   | All Steel                     |         |       |  |
| .....Size  | 1.75"H x 19"W x 5.3"D (1U)    |         |       | (4.4 cm x 48.3 cm x 13.5 cm)   |
| .....Weight  | 5 lb                          |         |       | (2.3 kg)   |
| Shipping: Size   | 4.5" x 20.3" x 13.75"         |         |       | (11.5 cm x 52 cm x 35 cm)  |
| .....Weight  | 9 lb                          |         |       | (4.1 kg)   |
| <i>Note 1: 0 dBu=0.775 Vrms</i>  |                               |         |       |  |
| <i>Note 2: Unless otherwise stated, all measurements made with Thresholds set at maximum, Ratios set at minimum.</i> |                               |         |       |  |



## Application Information

Traditionally, a product such as the DC 24 has been referred to as a "Compressor / Limiter" because the range of the Ratio control on the Compressor has been wide enough to accommodate both gentle compression and harder limiting effects. Not, however, simultaneously. One had to make a choice between the two modes of operation. On some models a Gate has been provided which may or may not be part of the Compressor function.

In the DC 24, all three functions of each channel are independent. Gating may occur when low-level signals are present, compression may occur when the level increases, and "peak-stop" limiting is available for high-level signals. This provides a three slope capability which is rather unique in the audio industry.

Additionally, the DC 24 can help out a great deal on the low end of the amplitude spectrum by serving as a noise gate simultaneously. The Compressor may be used to "tighten" vocals and instrumentals while leaving the Limiter function available for use as a safety valve.

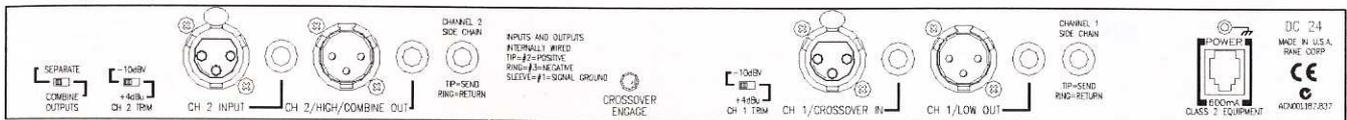
To accomplish this feat, the DC 24 provides three separate "Side Chains" in each Channel, each having its own set of front panel controls. For the Expander / Gate function, input signal is converted from an audio format to a control signal

and applied to the threshold circuit. If the output of the controller is below the specified threshold, it is passed along to the Expander / Gate Ratio control. The Ratio control allows attenuation of the controller to inhibit the slope of the Expander. After this attenuation, the control signal is delivered to the Channel's control summing amplifier where it will meet similar signals generated by the Compressor control system.

The Compressor controller works remarkably similarly to the Gate, the exception being the polarity. While the Gate circuit reduces gain when input level decreases below Threshold, the Compressor decreases gain when input increases above Threshold. The Compressor also receives the output of the controller, applies it to its threshold determinator, and passes the signal to the ratio attenuator if threshold conditions are satisfied. The output of the Ratio control is applied to the summing amplifier referenced in the gate section.

Side Chain inserts have been provided on the rear of the unit to allow the insertion of an equalizer into the control circuits of the Gate and the Compressor. This will allow the user to create a frequency-dependent threshold for the Gate and/or the Compressor. This feature is useful when attempting to control sibilance in vocals.

## Rear Panel



## Application Information...continued

The Limiter operates in an entirely different manner than the preceding sections. The control circuit for the Limiter monitors the output of the VCA, not the input of the unit. Anytime the output of the VCA exceeds the Threshold set on the front panel, Limiting begins to take place. The ratio of the Limiter is set automatically and is a function of the excess level the system is attempting to deliver above the preset Threshold. The attack and release time of the Limiter is a function of the speed at which the input signal is attempting to drive the output of the unit above the Threshold level.

The Crossover function of the DC 24 is based on Rane's time-proven 4th-order state-variable Linkwitz-Riley design.

This yields a 24 dB per octave slope and an in-phase characteristic. Since the outputs are in phase with each other, they recombine properly when the channel summing mode is selected via the rear panel Separate/Combine switch.

In its band-split mode, the DC 24 allows separate processing of low frequencies and high frequencies; a mode which makes its operation all the more transparent. When the Crossover is used in conjunction with a two-way loudspeaker system, adequate driver protection may be ensured while providing a very flexible means of program manipulation. For an overall view of the various operational modes, refer to "The DC 24 Users Guide" RaneNote.

## Architectural Specifications

The dynamic processor shall be a two (2) channel unit, each channel of which provides independent control over its gating, compression and limiting functions. The gating function shall provide a means for setting the gate threshold as well as the ratio of the function thus providing a means for gentler slopes to occur such as one would expect to find in an expander.

The compressor shall also provide a means for setting threshold and ratio independently. The limiter shall also provide a means for setting its operational threshold, but shall differ from the other two functions in that limit ratio shall be a function of limit level.

All attack and release characteristics provided by the dynamic controller shall be a function of the current program material, thus providing a high level of transparency to the listener.

The dynamic processor shall provide an active crossover circuit for the purpose of using the unit to drive amplifiers connected to two-way loudspeaker systems as well as for

dividing a single channel audio source into two frequency bands for ultimate recombination at the outputs of the device. The crossover shall be a fourth-order Linkwitz-Riley type configuration.

Passive bypass switches shall be provided to ensure total bypass of the unit's active circuitry in the event of power failure. The inputs and outputs shall be active balanced/unbalanced designs terminated with XLR & 1/4" TRS connectors. The side-chain send and receive connectors shall be 1/4" unbalanced types, wired tip=send, ring=return.

RFI filters shall be provided at the processor's inputs. LEDs shall be provided to indicate the presence of an input signal as well as high level overload conditions.

The unit shall be exempt from agency safety requirements and powered from a UL listed / CSA certified remote power supply (120 VAC), or CE approved (230 VAC) via a rear panel input modular plug. The unit shall be entirely constructed from cold-rolled steel, and mount into a standard EIA relay rack occupying 1 rack space.

*The unit shall be a Rane Corporation Model DC 24.*

## Available Accessories

- SC 1.7 Security Cover