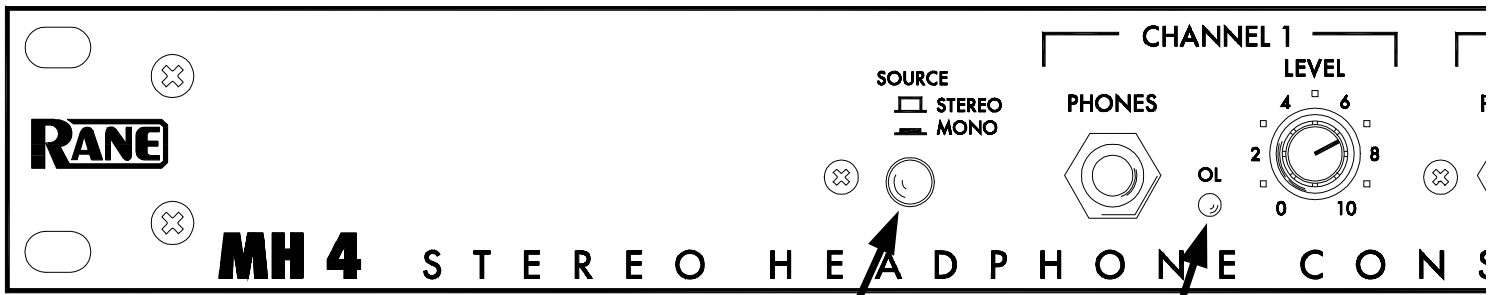


QUICK START

Connect the output from any stereo source such as a mixer or tape deck, and plug the left and right inputs into the respective **INPUT** jacks. The Inputs accept balanced or unbalanced sources. Just plug them in. This source is now routed to each of the four Outputs.

For a single mono source feeding all headphones, connect it to either one of the **INPUT** jacks and engage the **STEREO/MONO** switch. Set the **CHANNEL LEVEL** controls for individual headphone levels.

Never connect anything except a Rane power supply to the thing that looks like a telephone jack on the rear of the unit. This is an AC input and requires special attention if you do not have a power supply ***exactly*** like the one originally packed with your unit. See the full explanation of the power supply requirements elsewhere in this manual.



STEREO/MONO switch

Converts the INPUTS from stereo to mono so that a single input cable drives both sides of the headphones. In some instances a STEREO program may be confusing for live monitoring purposes, and switching to MONO improves intelligibility by summing the Left and Right signals.

OVERLOAD indicators

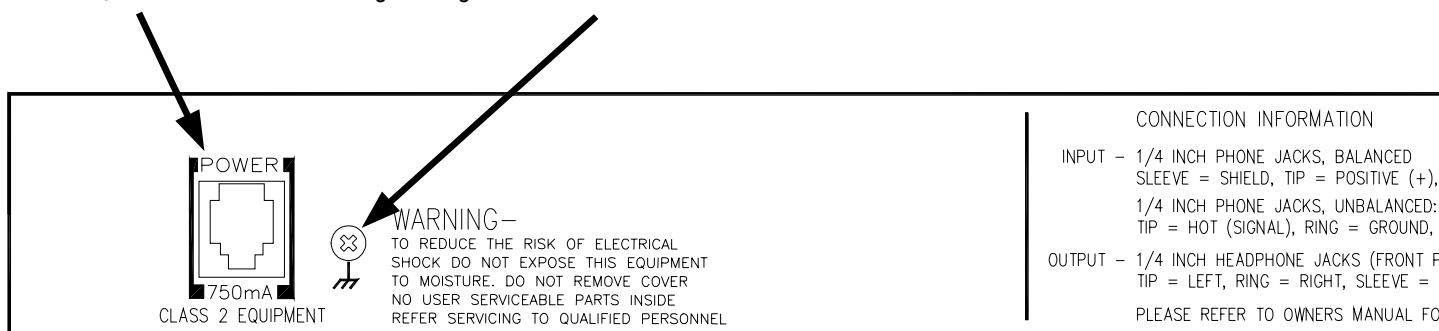
The red LEDs light when the input signal exceeds the MH 4's output capability (3 dB below maximum). Occasional flickering is acceptable. The overload point automatically varies with the headphones used.

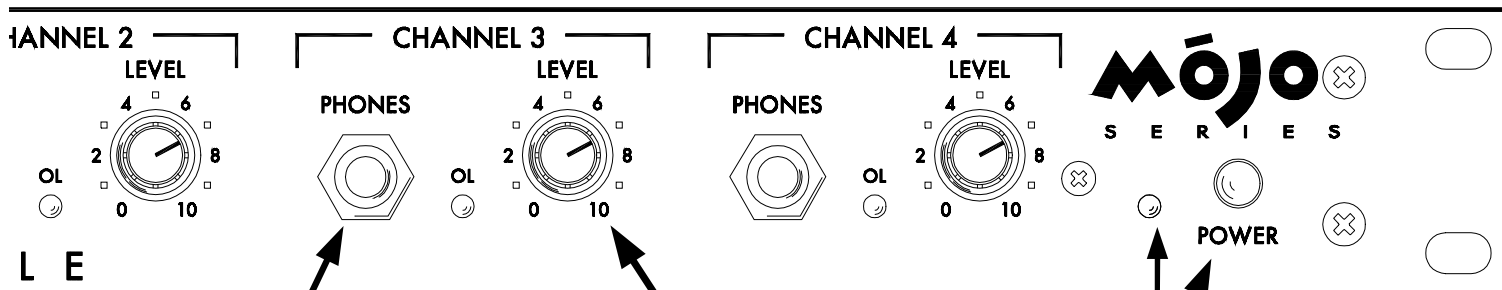
Remote POWER supply input

The unit 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 unit call for an 18 volt AC center-tapped transformer only. **This is not a telephone jack. Never use a power supply with your unit other than the one supplied or a replacement approved by Rane Corporation.** Using any other type of supply may damage the unit and void the warranty.

Chassis ground point

A screw is supplied for chassis grounding purposes. This unit comes with an outboard power supply which does not ground the chassis through the line cord. The MH 4 can be 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 this chassis grounding screw.





PHONE Output jacks

These stereo 1/4" TRS jacks accept standard 1/4" TRS stereo headphone plugs.

Individual LEVEL controls

These control the volume for each set of headphones as they are driven from the INPUTS. It's always a good idea to keep this control turned down before plugging in a pair of phones, then turn it up slowly.

POWER switch and LED

Your basic, straightforward power switch. When the yellow LED is lit, the MH 4 is ready to go.

INPUT jacks

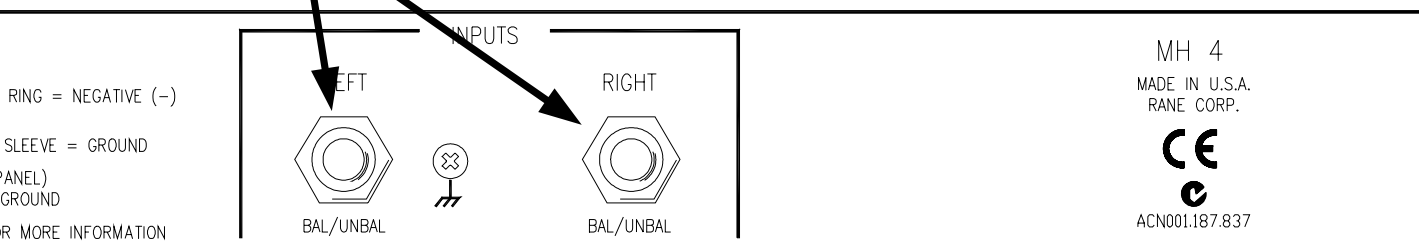
These are automatic balanced/unbalanced Inputs, which accept either a 1/4" TRS (Tip-Ring-Sleeve) plug for balanced operation, or a 1/4" TS (Tip-Sleeve) plug for unbalanced operation. A balanced line is best when connecting a cable over 10 feet in length. You do nothing different when hooking up balanced or unbalanced lines. The MH 4 is one smart animal.

MH 4 CONNECTION

With the power switch in the *off* (out) position, plug the power cord into the appropriate AC power source indicated on the rear panel. Locate the power supply case away from the MH 4 and other hum sensitive equipment.

Begin with all LEVEL controls counterclockwise at "0". Plug the outputs from a mono or stereo source into the INPUTS.

See Sound System Interconnection on page 8 for more information on proper cable wiring between devices.



UNDERSTANDING HEADPHONE POWER REQUIREMENTS

HEADPHONE SENSITIVITY

Headphone manufacturers specify a “sensitivity” rating for their products that is very similar to loudspeaker sensitivity ratings. For loudspeakers, the standard is to apply 1 watt and then measure the sound pressure level (SPL) at a distance of 1 meter. For headphones, the standard is to apply 1 milliwatt ($1 \text{ mW} = 1/1000$ of a watt) and then measure the sound pressure level at the earpiece (using a dummy head with built-in microphones). Sensitivity is then stated as the number of dB of actual sound level (SPL) produced by the headphones with 1 mW of input; headphone specifications commonly refer to this by the misleading term “dB/mW.” What they really mean is dB SPL for 1 mW input.

Think about these sensitivity definitions a moment: headphone sensitivity is rated using $1/1000$ of a watt; loudspeaker sensitivity is rated using 1 watt. So a quick rule-of-thumb is that you are going to need about $1/1000$ as much power to drive your headphones as to drive your loudspeakers since both of their sensitivity ratings are similar (around 90-110 dB-SPL). For example, if your hi-fi amp is rated at 65 watts, then you would need only 65 mW to drive comparable headphones. (Actually you need less than 65 mW since most people don’t listen to their loudspeakers at 1 meter.) And this is exactly what you find in hi-fi receivers—their headphone jacks typically provide only 10-20 mW of output Power.

Take another moment and think about all those portable tape players. Ever hear one? They sound great, and loud. Why you can even hear the headphones ten feet away as the teenage skateboarder that ran over your foot escapes.

Power output? About 12 mW.

As you can see from the chart below, headphones near 75 ohms impedance produce the highest power levels from the MH 4. However, headphone sensitivities vary widely, and are not merely a function of power.

THE LIST

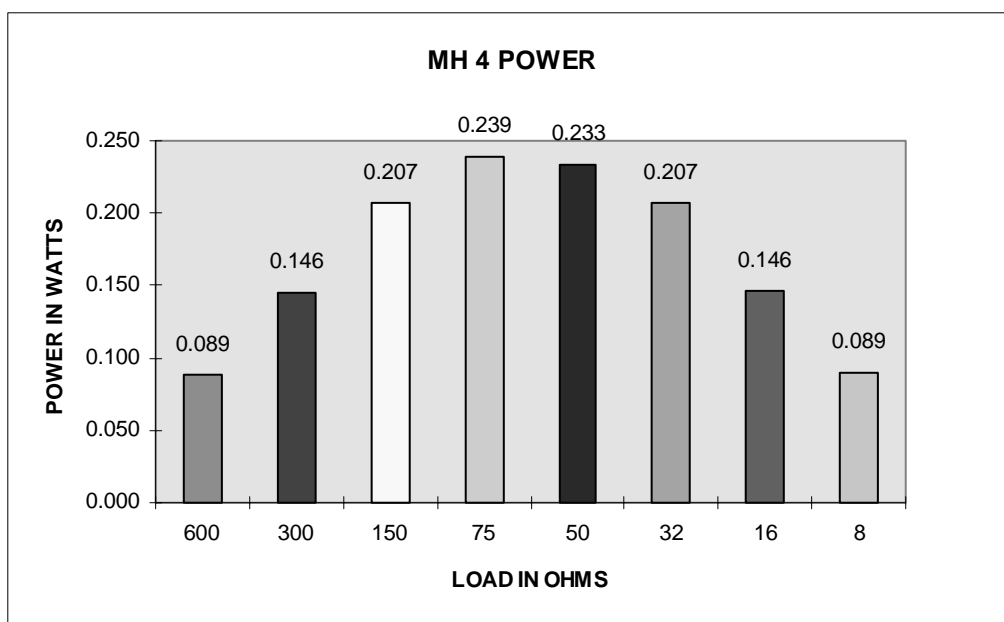
As an aid in finding out how much power is available from the MH 4 Headphone Console we have compiled a listing of popular headphones. To the right is a column giving the maximum SPL obtainable using the MH 4 and any particular headphone—ultimately, it all gets down to actual SPL. The power rating really doesn’t matter at all—either it’s loud enough or it isn’t (of course it has to be clean power, not clipped and distorted). The SPL numbers shown are for maximum *continuous* SPL; for momentary peak SPL add 3 dB.

Note that the maximum achievable SPL varies widely for different models and manufacturers, ranging from a low of 107 dB to a harmful 133 dB! The table also shows there is very little relationship between headphone impedance and sensitivity, and that power output *alone* means nothing, since in one case 89 mW produces a maximum SPL of 107 dB, yet in another case the same 89 mW yields an SPL of 117 dB!

Sensitivity dB is measured sound pressure level with 1 mW of power. The MH 4 Max Power mW column is typical continuous average power, 20 Hz-20 kHz, with THD less than 0.1%.

If headphones are not yet owned, or replacements are desired, use this listing as a guide for selecting head-phones with sufficient sensitivity for the maximum desired SPL.

Note: headphones with an impedance of less than 32 ohms are not recommended for use with the MH 4.



MH 4 power with all Channels driven simultaneously or with any combination

Manufacturer	Model	Impedance (ohms)	Sensitivity (dB)	MH 4 Max Power (mW)	MH 4 Max SPL (dB)
AKG	K141M	600	98	89	117
	K240M, K240DF	600	88	89	107
	K270S	75	92	239	115
	K301	100	94	225	118
	K401, K501	120	94	220	117
Audio-Technica	ATH-COM1, ATH-COM2, ATH-908	40	90	220	113
	ATH-910	40	92	220	115
	ATH-P5	40	100	220	123
	ATH-M40	60	100	238	123
	ATH-D40	66	102	235	126
Beyerdynamic	ATH-M2X, ATH-M3X	45	100	230	123
	DT150	250	97	160	119
	DT211, DT311	40	98	220	121
	DT250	80	98	240	121
	DT411	250	102	160	124
Fostex	DT 531	250	95	160	116
	DT431, DT331	40	86	220	109
	DT770PRO, DT990PRO	600	96	89	115
	DT801, DT811, DT511	250	94	160	116
	DT901, DT911	250	98	160	120
Grado	T-5	44	96	225	119
	T-7	70	98	240	121
	T-20	50	96	233	120
	T-40	50	98	233	122
	SR 325	40	96	220	119
Hosa	HDS-701	40	91	220	114
	A/250, A/200, A/130, TD/80	60	98	238	123
	R/200	60	84	238	108
	R/100, R/45	60	85	238	109
	R/90, HD/2, SB/15	60	100	238	123
Koss	R/80, R/35S, R/20, Porta Pros	60	101	238	124
	R/70B, R/55B, SB/50, SB/35	60	101	238	124
	R/40	60	90	238	114
	R/30S	60	106	238	130
	R/10	60	103	238	127
MB Quart	TD/75	60	95	238	119
	TD/65	90	101	235	124
	TD/61	38	93	212	116
	QP 805	300	98	145	120
	HD 400, 433, 435, 470	32	94	200	117
Sennheiser	HD25	70	120	240	144
	HD445	52	97	235	121
	HD25SP	85	100	235	123
	HD265, 525, 535, 545, 565	150	94	207	117
	HD455, 475	60	94	238	118
Sony	HD465	100	94	225	118
	HD 570	120	95	220	110
	HD580, 600	300	97	145	118
	MDR-V100MK2	32	98	200	121
	MDR-85	40	102	220	125
Stanton	MDR-V600, MDR-D77	45	106	230	129
	MDR-CD10	32	96	200	119
	MDR-CD550, CD750	45	100	230	123
	MDR-CD6	45	110	230	133
	MDR-CD850, CD950	32	102	200	125
Technics	MDR-CD1000, CD3000	32	104	200	127
	MDR-D33, MDR-D55, MDR-7504	45	104	230	127
	MDR-7506	63	106	240	129
	MDR-7502	45	102	230	125
	ST PRO, DJ PRO 1000	32	100	200	123
Telex	RP-DJ1200	32		200	
	PH-6	600	105	89	124
	RH5MA	32	98	200	121
	RH1	32	90	200	113
	RH2	32	95	200	118
Yamaha	RH3	60	95	238	119
	RH10M	40	102	220	125
	RH40M	32	103	200	126

SOUND SYSTEM INTERCONNECTION

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.)*

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. 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].

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**. Your audio dealer can recommend such a transformer.

The goal of transformer 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.

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). Do not be tempted to use 3-prong to 2-prong "cheater" adapters to lift grounds. This is a dangerous and illegal practice.

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 can create 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 outputs). 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.

See the following page for suggested cable assemblies for your particular interconnection needs. Find the appropriate output configuration from your mixer output (down the left side), and then match this with the correct balanced or unbalanced input to the MH 4 (down the right side.) An "off-the-shelf" cable may be available or modifiable. Soldering should only be attempted by those trained in the art.

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

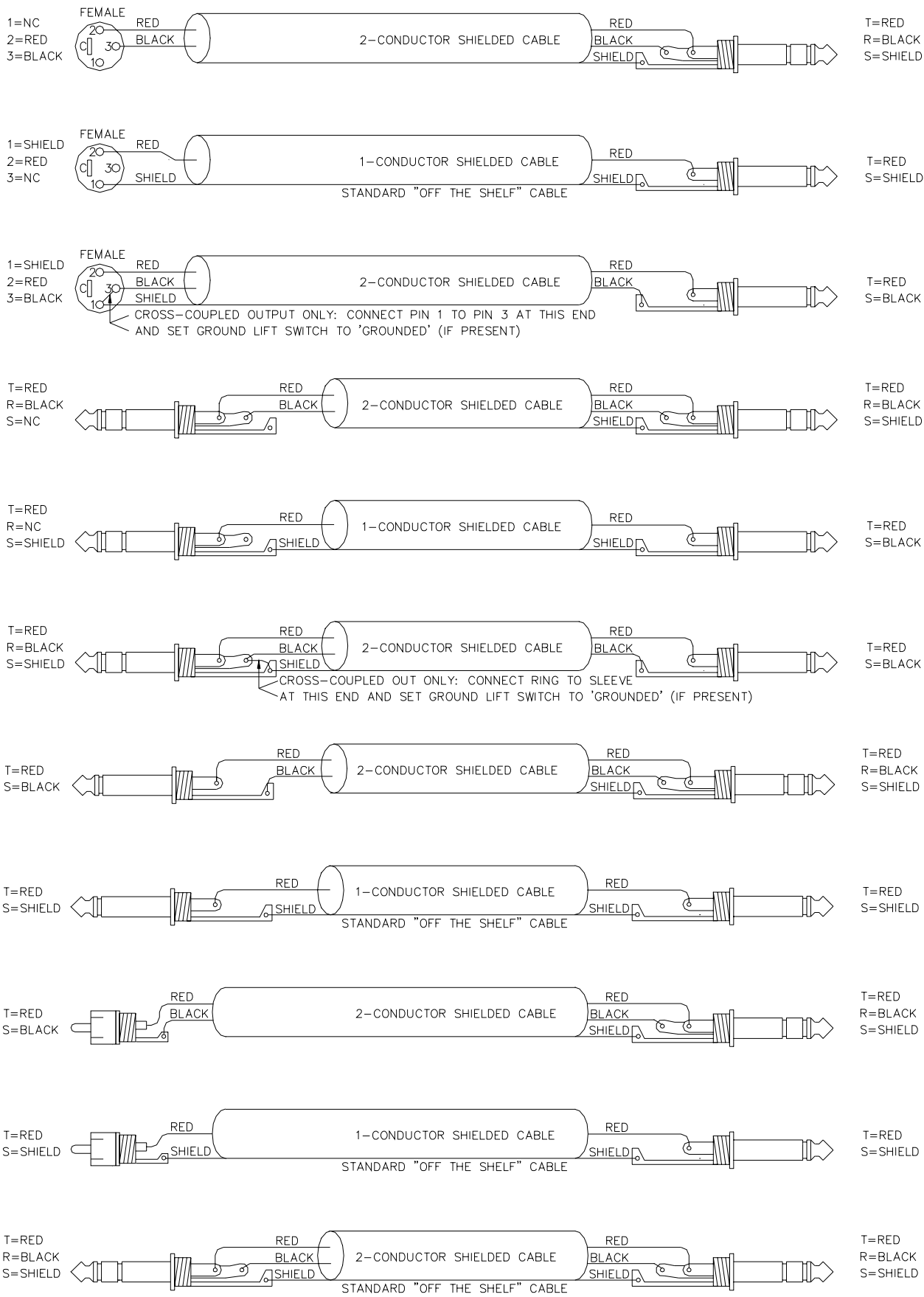
- Use balanced connections whenever possible.
- Transformer isolate all unbalanced connections from balanced connections.
- Use special cable assemblies when unbalanced lines cannot be transformer isolated.
- Any unbalanced cable must be kept under ten feet (three meters) in length. Lengths longer than this will amplify the nasty side effects of unbalanced circuitry's ground loops.

This information was condensed from Rane Note 110, "Sound System Interconnection". If you would like the complete note, call or email the factory, download it from Rane's web site, or ask your dealer for a copy.

VARIOUS MH 4 INPUT CABLE ASSEMBLIES

FROM OUTPUT

TO MH 4 INPUT



MOJO GLOSSARY

balanced line The recommended method of interconnecting audio equipment. A balanced line requires three conductors: a twisted-pair for the signal (positive and negative) and an overall shield. *The shield must be tied to the chassis at both ends for hum-free interconnect.*

bandwidth *Abbr. BW* The numerical difference between the upper and lower -3 dB points of an audio band.

clipping What occurs when a unit tries to produce a signal *larger than its power supply*. The signal takes on a flat-topped, or *clipped* shape. When an amplifier tries to go above its max power, it *clips*.

compressor A signal processing device used to *reduce the dynamic range* of the signal passing through it. For instance, an input dynamic range of 110 dB might pass through a compressor and exit with a new dynamic range of 70 dB. The modern usage for compressors is to turn down (or reduce the dynamic range of) just the loudest signals. Other applications use compressors to control the *creation* of sound. When used in conjunction with microphones and musical instrument pick-ups, compressors help determine the final timbre by selectively compressing specific frequencies and waveforms.

connectors Audio equipment uses different styles:

RCA An *unbalanced* pin connector commonly used on consumer and some pro equipment; aka *phono plug*

XLR A 3-pin connector common on pro audio equipment.

Preferred for *balanced line* interconnect; aka *Cannon plug*

¼" TRS 1. *Stereo* ¼" connector consisting of *tip* (T), *ring* (R), and *sleeve* (S) sections, with T = *left*, R = *right*, and S = *ground/shield*. 2. *Balanced* interconnect with the pos & neg signal lines tied to T and R respectively and S acting only as an overall shield. 3. *Insert loop* interconnect with T = *send*, R = *return*, and S = *ground/shield*. [Think: *ring, right, return*]

¼" TS *Mono* ¼" connector consisting of *tip* (T) [signal] and *sleeve* (S) [ground & shield] for *unbalanced* wiring.

constant-Q equalizer (also **constant-bandwidth**) The bandwidth remains constant for all boost/cut levels. Since Q and bandwidth are interrelated, the terms are fully interchangeable.

decibel *Abbr. dB* (named after *Alexander Graham Bell*). The preferred method and term for representing the *ratio* of different audio levels. Being a ratio, *decibels have no units*. Everything is relative. So it must be relative to some *0 dB reference point*. A suffix letter is added to distinguish between reference points:

0 dBu A reference point equal to 0.775 V

+4 dBu Standard pro reference level equal to 1.23 V

0 dBV A reference point equal to 1.0 V

-10 dBV Standard reference level for consumer and some pro audio use, equal to 0.316 V. *RCA* (phono) connectors are a good indicator of units operating at -10 dBV

dynamic range The ratio of the loudest signal to the quietest signal in a unit or system as expressed in *decibels* (dB).

expander A signal processing device used to *increase the dynamic range* of the signal passing through it. Expanders complement compressors. For example, a compressed input dynamic range of 70 dB might pass through an expander and exit with a new *expanded* dynamic range of 110 dB. Modern expanders usually operate only *below a set threshold point*, i.e., they operate only on low-level audio. The term *downward expander* describes this type of application.

ground Any electrical reference point for measuring voltage levels. Usually a large conducting body, such as the earth or an electric circuit connected to the earth. Chassis should always be at earth potential.

WARNING: SHOCK HAZARD *Never use an AC line cord ground-lift adapter or cut off the 3rd pin. It is illegal and dangerous.*

headroom The level in dB between the typical operating level and *clipping*. For example, a nominal +4 dBu system that clips at +20 dBu has 16 dB of *headroom*.

hum Unwanted sound contaminating audio paths due to EMI (electro-magnetic interference) caused by AC power-lines & transformers getting into unbalanced, poorly shielded, or improperly grounded connecting cables. Hum has a definite smooth (sine wave) repetitive sound based on the harmonics of 50/60 Hz such as 100/120 Hz and 150/180 Hz.

interpolating Term meaning to insert between two points. If a graphic equalizer's adjacent bands, when moved together, produce a smooth response without a dip in the center, they are *interpolating* between the fixed center frequencies.

levels Terms used to describe relative audio signal levels:

mic-level Nominal signal coming directly from a microphone.

Very low, in the microvolts, and requires a preamp with at least 60 dB gain before using with any *line-level* equipment.

line-level Standard +4 dBu or -10 dBV audio levels.

instrument-level Nominal signal from musical instruments using electrical pick-ups. Varies widely, from very low *mic-levels* to quite large *line-levels*.

limiter A compressor with a fixed *ratio* of 10:1 or greater. The dynamic action prevents the audio signal from becoming larger than the *threshold* setting.

Linkwitz-Riley crossover The most preferred active crossover design. It features steep 24 dB/octave slopes, in-phase outputs, and flat amplitude response. Due to the in-phase outputs the acoustic lobe resulting when both loudspeakers reproduce the crossover frequency is always on-axis (not tilted up or down) and has no peaking.

noise 1. *Interconnect*. Unwanted sounds contaminating audio paths. RFI (radio frequency interference) caused by broadcast signals leaking into unbalanced, poorly shielded, or improperly grounded connecting cables. Also by light dimmers, motor controls and computers. 2. *Music*. A random mix of audio frequencies not harmonically related, sounding like radio static.

polarity A signal's electromechanical potential with respect to a reference. For example, a microphone has *positive polarity* if a positive pressure on its diaphragm results in a positive output voltage. **polarity vs. phase shift:** *polarity* refers to a signal's *reference* NOT to its *phase shift*. Being 180 degrees *out-of-phase* and having *inverse polarity* are DIFFERENT things. We wrongly say something is *out-of-phase* when we mean it is *inverted*. One occurs over a period of *time*; the other occurs instantaneously.

Q (upper-case) Quality factor. Defined to be the ratio of the center frequency *f* divided by the bandwidth *BW* for a bandpass filter.

signal-to-noise ratio The ratio in dB between a reference level and the noise floor. For example, a signal-to-noise ratio of 90 dB re +4 dBu, means the noise floor is 90 dB below a +4 dBu ref.

unbalanced line An audio interconnect scheme using one wire with an overall shield. The shield must perform two functions: act as the return signal path (*ground*) and to protect the conductor from noise (*shield*). Consequently this method is vulnerable to hum & noise problems.

unity gain A gain setting of one. The level out equals the level in.