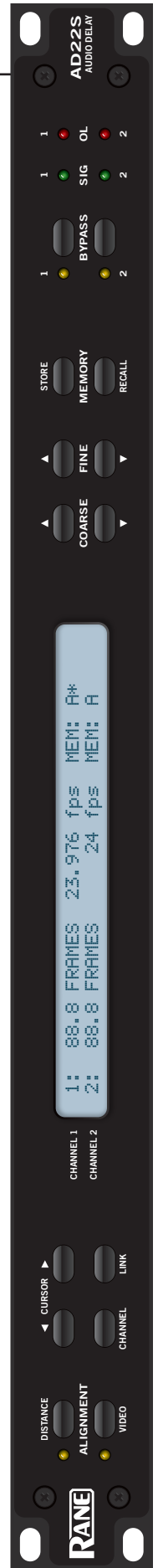




# AD22S

AUDIO DELAY



## CONTENTS *(in order of appearance)*

- Important Safety Instructions
- AD22S Manual
- AD22S Data Sheet
- Sound System Interconnection
- Rane Professional Live Sound Products
- Warranty
- Declaration of Conformity

22265

# IMPORTANT SAFETY INSTRUCTIONS



1. Read these instructions.
  2. Keep these instructions.
  3. Heed all warnings.
  4. Follow all instructions.
  5. Do not use this apparatus near water.
  6. Clean only with a dry cloth.
  7. Do not block any ventilation openings. Install in accordance with manufacturer's instructions.
  8. Do not install near any heat sources such as radiators, registers, stoves, or other apparatus (including amplifiers) that produce heat.
  9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding-type plug has two blades and a third grounding prong. The wide blade or third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
  10. Protect the power cord and plug from being walked on or pinched particularly at plugs, convenience receptacles, and the point where it exits from the apparatus.
  11. Only use attachments and accessories specified by Rane.
  12. Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
  13. Unplug this apparatus during lightning storms or when unused for long periods of time.
  14. 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 is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
  15. The plug on the power cord is the AC mains disconnect device and must remain readily operable. To completely disconnect this apparatus from the AC mains, disconnect the power supply cord plug from the AC receptacle.
  16. This apparatus shall be connected to a mains socket outlet with a protective earthing connection.
  17. When permanently connected, an all-pole mains switch with a contact separation of at least 3 mm in each pole shall be incorporated in the electrical installation of the building.
  18. If rackmounting, provide adequate ventilation. Equipment may be located above or below this apparatus, but 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 apparatus.
  19. This apparatus may be installed in an industry standard equipment rack. Use screws through all mounting holes to provide the best support.
- WARNING:** To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture. Apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases, shall be placed on the apparatus.

## WARNING



To reduce the risk of electrical shock, do not open the unit. No user serviceable parts inside. Refer servicing to qualified service personnel.

The symbols shown below are internationally accepted symbols that warn of potential hazards with electrical products.



This symbol indicates that a dangerous voltage constituting a risk of electric shock is present within this unit.



This symbol indicates that there are important operating and maintenance instructions in the literature accompanying this unit.

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

**NOTE:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**CAUTION:** Changes or modifications not expressly approved by Rane Corporation could void the user's authority to operate the equipment.

# INSTRUCTIONS DE SÉCURITÉ



1. Lisez ces instructions.
2. Gardez précieusement ces instructions.
3. Respectez les avertissements.
4. Suivez toutes les instructions.
5. Ne pas utiliser près d'une source d'eau.
6. Ne nettoyer qu'avec un chiffon doux.
7. N'obstruer aucune évacuation d'air. Effectuez l'installation en suivant les instructions du fabricant.
8. Ne pas disposer près d'une source de chaleur, c-à-d tout appareil produisant de la chaleur sans exception.
9. Ne pas modifier le cordon d'alimentation. Un cordon polarisé possède 2 lames, l'une plus large que l'autre. Un cordon avec tresse de masse possède 2 lames plus une 3<sup>e</sup> pour la terre. La lame large ou la tresse de masse assurent votre sécurité. Si le cordon fourni ne correspond pas à votre prise, contactez votre électricien.
10. Faites en sorte que le cordon ne soit pas piétiné, ni au niveau du fil, ni au niveau de ses broches, ni au niveau des connecteurs de vos appareils.
11. N'utilisez que des accessoires recommandés par Rane.
12. N'utilisez que les éléments de transport, stands, pieds ou tables spécifiés par le fabricant ou vendu avec l'appareil. Quand vous utilisez une valise de transport, prenez soin de vous déplacer avec cet équipement avec prudence afin d'éviter tout risque de blessure.
13. Débranchez cet appareil pendant un orage ou si vous ne l'utilisez pas pendant un certain temps.
14. Adressez-vous à du personnel qualifié pour tout service après vente. Celui-ci est nécessaire dans n'importe quel cas où l'appareil est abîmé : si le cordon ou les fiches sont endommagés, si du liquide a été renversé ou si des objets sont tombés sur l'appareil, si celui-ci a été exposé à la pluie ou l'humidité, s'il ne fonctionne pas correctement ou est tombé.
15. La fiche du cordon d'alimentation sert à brancher le courant alternatif AC et doit absolument rester accessible. Pour déconnecter totalement l'appareil du secteur, débranchez le câble d'alimentation de la prise secteur.
16. Cet appareil doit être branché à une prise terre avec protection.
17. Quand il est branché de manière permanente, un disjoncteur tripolaire normalisé doit être incorporé dans l'installation électrique de l'immeuble.
18. En cas de montage en rack, laissez un espace suffisant pour la ventilation. Vous pouvez disposer d'autres appareils au-dessus ou en-dessous de celui-ci, mais certains (tels que de gros amplificateurs) peuvent provoquer un buzz ou générer trop de chaleur au risque d'endommager votre appareil et dégrader ses performances.
19. Cet appareil peut-être installé dans une baie standard ou un chassis normalisé pour un montage en rack. Visser chaque trou de chaque oreille de rack pour une meilleure fixation et sécurité.

**ATTENTION:** afin d'éviter tout risque de feu ou de choc électrique, gardez cet appareil éloigné de toute source d'humidité et d'éclaboussures quelles qu'elles soient. L'appareil doit également être éloigné de tout objet possédant du liquide (boisson en bouteilles, vases,...).

## ATTENTION



Afin d'éviter tout risque de choc électrique, ne pas ouvrir l'appareil. Aucune pièce ne peut être changée par l'utilisateur. Contactez un SAV qualifié pour toute intervention.

Les symboles ci-dessous sont reconnus internationalement comme prévenant tout risque électrique.



Ce symbole indique que cette unité utilise un voltage élevé constituant un risque de choc électrique.



Ce symbole indique la présence d'instructions d'utilisation et de maintenance importantes dans le document fourni.

**REMARQUE:** Cet équipement a été testé et approuvé conforme aux limites pour un appareil numérique de classe B, conformément au chapitre 15 des règles de la FCC. Ces limites sont établis pour fournir une protection raisonnable contre tout risque d'interférences et peuvent provoquer une énergie de radiofréquence s'il n'est pas installé et utilisé conformément aux instructions, peut également provoquer des interférences aux niveaux des équipements de communication. Cependant, il n'existe aucune garantie que de telles interférences ne se produiront pas dans une installation particulière. Si cet équipement provoque des interférences en réception radio ou télévision, ceci peut être détecté en mettant l'équipement sous/hors tension, l'utilisateur est encouragé à essayer de corriger cette interférence par une ou plusieurs des mesures suivantes:

- Réorienter ou déplacer l'antenne de réception.
- Augmenter la distance entre l'équipement et le récepteur.
- Connecter l'équipement à une sortie sur un circuit différent de celui sur lequel le récepteur est branché.
- Consulter un revendeur ou un technicien radio / TV expérimenté.

**ATTENTION:** Les changements ou modifications non expressément approuvés par Rane Corporation peuvent annuler l'autorité de l'utilisateur à manipuler cet équipement et rendre ainsi nulles toutes les conditions de garantie.

CAN ICES-3 (B)/NMB-3(B)



Cartons et papier à recycler.

**RANE**



## QUICK START

Your AD22S is out of its box, and now it's time to integrate it with your audio setup. But wait! What are these buttons for? What do all those numbers on the display mean? This guide intends to help you quickly learn the basics and familiarize you with the device so there's no delay before you delay.

### FRONT PANEL CONTROLS

The first thing to decide is which alignment mode to use. If you're using the AD22S to synchronize audio with video, then select Video mode. Otherwise select Distance alignment. The DISTANCE and VIDEO buttons on the left hand side of the unit switch between the two modes. Display settings and delay values are controlled by using the CHANNEL button to toggle between channels 1 or 2, and by using the CURSOR buttons to select the value you wish to change. The COARSE and FINE buttons increment or decrement the value currently selected.

### DISTANCE ALIGNMENT

One of the main applications for the AD22S is synchronizing an audio signal coming from separate sources at two different distances. Say, for example, you want the music emanating from a stack of loudspeakers on the lawn at an amphitheater to get to your audience at exactly the same time as sound coming from the speaker arrays on stage. The amount of delay needed is the time it takes sound to travel from the stage to the lawn. While in DISTANCE mode, this can be displayed in feet, meters, or milliseconds.

### VIDEO ALIGNMENT

The AD22S is also excellent for synchronizing audio with video feeds, especially in a live environment where video processing typically adds several milliseconds to the signal that can have a noticeable effect on the final output. To assist in this application, the AD22S can show your delay value directly in terms of frames. All common frame rates for NTSC and PAL/SECAM are supported, and the audio stream can be delayed with a precision of 0.5 frames to line up perfectly with any video stream.

### SETTING DELAY

Use the ◀ CURSOR ▶ buttons to select the unit type, then press the COARSE or FINE buttons to cycle through options. In Distance mode, choose between feet, meters, or milliseconds; in Video mode the delay is shown in frames or milliseconds. If you know the distance between the sources you are summing, set the units for feet or meters.

The ambient temperature also affects the speed of sound. To set the temperature, use the CURSOR buttons to select either °C or °F, then set the value to the approximate temperature at your speaker location. The AD22S calculates the correct delay based on your environment.

*Note:* Changing units from distance to time does not change the output delay. For example, if you are viewing the settings for channel 1 in meters, a change from meters to milliseconds keeps the same amount of delay but shows it in milliseconds rather than distance.

### LINKING CHANNELS

The LINK button connects the controls so that all changes apply to both channels. Channels do not need to share the same setting. While linked, incrementing or decrementing a value changes the delay for both channels at once. To treat the channels as a stereo pair, first set the delay value to the same setting on both channels before pressing the LINK button.

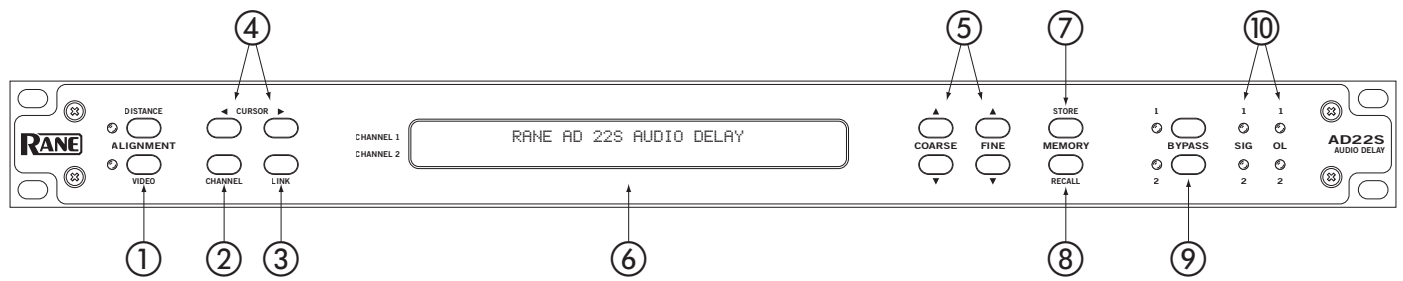
### MEMORY FUNCTIONS

Each channel has two memory banks, A and B. The ⚡ character at the right of the display indicates that the current setting does not match what is stored in memory.

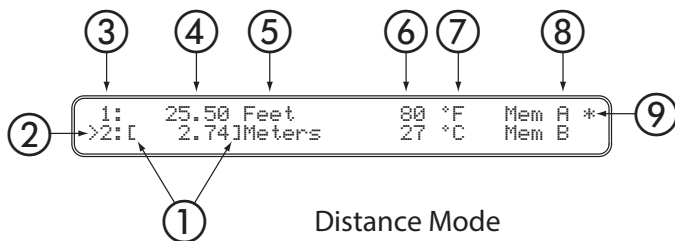
Pressing STORE copies the current settings into the selected Memory, clearing the ⚡ character. The cursor must be over the Memory Bank field before pressing STORE. To activate a stored setting, press RECALL to change the active delay to the value stored in the memory location shown. If channels are linked, both will be recalled.

**Additional features are described in Operation Details on page Manual-4.**

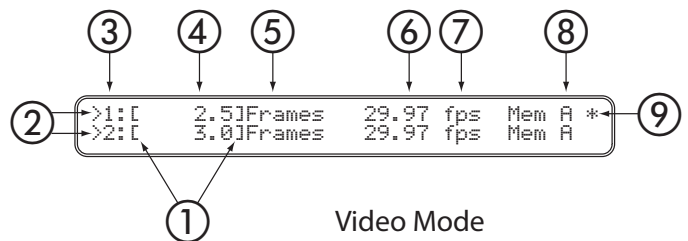
# FRONT PANEL DESCRIPTION



- ① ALIGNMENT MODE buttons: Press DISTANCE for delay in feet, meters, or milliseconds. Press VIDEO for alignment by frames or milliseconds.
- ② CHANNEL button: Press this to switch the cursor location between channels. This button has no effect if the channels are linked.
- ③ LINK button: Links channels together so changes made affect both channels at once. To treat the channels as a stereo pair, make sure settings for each channel are identical before pressing the LINK button. Press the LINK button again to unlink.
- ④ CURSOR buttons: Press ◀ left or right ▶ cursor to select the value for editing.
- ⑤ COARSE and FINE controls: These buttons affect the setting that is currently highlighted to change settings or delay values. COARSE increments or decrements delay by 1 ms/feet/meters or 1.0 frames, FINE by 0.1 ms/feet/meters or 0.5 frames.
- ⑥ LCD Display: Shows the current readout of settings for each channel. Fields may be selected using the CURSOR buttons and changed using the COARSE / FINE controls. See the DISPLAY sections below.
- ⑦ STORE button: Stores the Delay configuration into current memory for the selected channel. If the asterisk \* character is shown to the right of the display, the current value does not match the memory location.
- ⑧ RECALL button: Copies the stored delay setting into the active channel. If channels are linked, then both are recalled.
- ⑨ BYPASS buttons: Toggle relays for each channel. If LED is on, bypass is enabled and the device functions like a wire. If bypass LED is off, the channel is active.
- ⑩ SIGNAL / OVERLOAD LEDs: SIG LEDs indicate signal presence on the input. OL LEDs light red when an input signal is near the maximum level and may clip.



Distance Mode



Video Mode

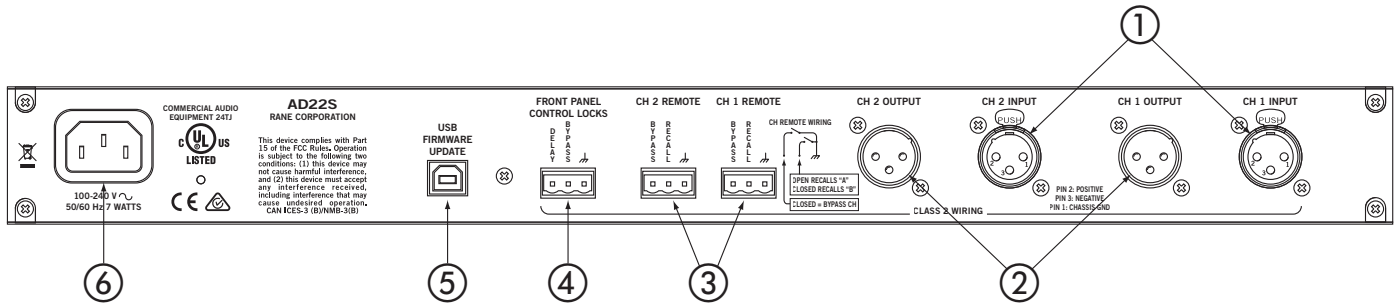
## DISPLAY: DISTANCE MODE

- ① Cursor
- ② Active Channel(s)
- ③ Channel #
- ④ Delay Setting
- ⑤ Units (Feet, Meters, ms)
- ⑥ Temperature
- ⑦ Temp. Units
- ⑧ Mem. Bank
- ⑨ Memory Indicator - \* Shown if different than stored value

## DISPLAY: VIDEO MODE

- ① Cursor
- ② Active Channel(s)
- ③ Channel #
- ④ Value
- ⑤ Units (Frames, ms)
- ⑥ Frame rate
- ⑦ Units (Frames per second)
- ⑧ Mem. Bank
- ⑨ Memory Indicator - \* Shown if different than stored value

# REAR PANEL DESCRIPTION



- ① CHANNEL INPUTS: Balanced XLR input jacks, 24 dBu max level.
- ② CHANNEL OUTPUTS: Balanced XLR outputs, 600  $\Omega$  min. load.
- ③ REMOTE RECALL terminals: Wire external switches to remotely recall Memory settings or toggle bypass relays. See the REMOTE RECALL section.
- ④ FRONT PANEL CONTROL LOCKS: A wired external switch disables the front panel controls to prevent accidental changes.
- ⑤ USB FIRMWARE UPDATE: This USB connection facilitates possible firmware upgrades in the future. This port provides no other functions and should not be connected during normal use. See the FIRMWARE UPDATE section on the next page.
- ⑥ UNIVERSAL POWER SUPPLY: Universal IEC power jack connects anywhere in the world to AC line voltage, 100-240 VAC @ 50 – 60 Hz.

## OPERATING DETAILS

### INITIAL SETUP

The AD22S is always on while plugged in. When first powered up, the LCD briefly displays the words “Rane AD22S Audio Delay” and the current firmware revision. Out of the box, both channels are in BYPASS mode with the inputs routed directly to the outputs. This makes it easy to set up and verify that signals are present before turning on any delay. The yellow bypass indicators mean that BYPASS is active; press each BYPASS button to disable.

### ALIGNMENT MODE

Two modes of operation are available. If working with video and wish to set delay by number of frames, press VIDEO for video alignment. Otherwise press DISTANCE for distance alignment. Both modes offer milliseconds as a simple display option in addition to their distance or video functions.

### SETTING THE DELAY

A ‘>’ by the channel number indicates the channel is selected for editing. This appears on both channels if LINK is active.

**Distance Mode:** Use CURSOR buttons to highlight the unit type, then select between milliseconds, feet, or meters. The AD 22S also needs to know the temperature. To set, select and set the unit type to °C or °F, then select and set the temperature.

**Video Mode:** Choose between frames or milliseconds as the display setting. For frames, the delay value is based on the number of frames per second, denoted by “fps” on the display. Set this first and make sure it matches your video frame rate.

**Linked Channels:** With channels linked, any changes made are applied to both channels at once. This does not force the delay values to be the same.

*Example:* For two speaker arrays at different distances from a performer, linking the two channels lets you change temperature settings for both at once.

For stereo operation, set each channel to the same value before pressing LINK.

### STORING DELAYS

The ✱ character on the display means the current setting differs from the memory bank shown. Move the CURSOR to the memory field, then press COARSE or FINE to toggle between Mem A or Mem B. Press STORE to copy the current setting into this location. Note that ✱ is no longer displayed. If channels are linked, both channels will be stored.

*Note:* The CURSOR must be on the Memory Bank field to STORE. This is to prevent an accidental overwrite of saved settings.

### RECALLING DELAYS

Press RECALL to copy from the Memory shown to the active setting for the selected channel. If LINK is active, both channels will be recalled. This will overwrite any current settings.

### REMOTE RECALL

The REMOTE RECALL terminals on the rear of the unit are functionally equivalent to the RECALL button. With a switch wired between the RECALL terminal and the GND terminal, close the switch to recall Memory B. Open the switch to recall Memory A.

### FIRMWARE UPDATE

Should a firmware upgrade become available, it will be posted on the AD22S page at [www.rane.com/ad22s.html](http://www.rane.com/ad22s.html). The USB port provides the connection to a PC enabling the file transfer. Perform the following steps to update:

1. Ensure the unit is powered.
2. Connect via device cable to USB port on computer.
3. AD22S appears as an EXTERNAL DISK device containing one file (named “AD22S\_XX.BIN” or similar).
4. Delete this file. NOTE: After deleting this file, the folder may disappear, then re-open after a few seconds.
5. Copy or drag the new firmware file to the AD22S.
6. After transfer, the AD22S restarts automatically and briefly displays the new revision info. It may also reappear as an EXTERNAL DISK on the PC containing the new firmware file.
7. Disconnect USB cable and resume normal operation.

**Notes:** If the revision number displayed does not match the new firmware, make sure you have the latest file and try again.

*Tip:* Press and hold both CURSOR buttons simultaneously for one second to view the currently running firmware version.

If an error occurs during transfer or a file is corrupted, the AD 22S will revert to the last working version.





## General Description

The Rane AD22S is a fully balanced two-input, two-output Audio Delay unit designed for multiple applications, including speaker array synchronization and precision audio-to-video alignment. With two distinct modes, the AD22S offers the functionality of dedicated devices within a single rack unit. Featuring a range of 2.00 to 999.99 ms, this unit provides delay displayed in units of time, distance, or frames. Use the dedicated Video mode to provide almost a full second of audio delay in 0.5 frame increments for all standard NTSC or PAL/SECAM frame rates.

The AD22S can operate as two independent channels or as a linked or stereo pair. Front panel controls let you choose settings for each channel that can be stored into two nonvolatile memory

locations for quick and easy access at any time. Bypass relays for each channel automatically connect should the device lose power. Your settings are always saved into working memory and restored upon power up. Rear terminals let you connect standard switches to recall settings remotely.

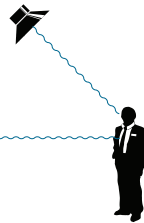
The AD22S's balanced XLR inputs and outputs offer the Rane standard of audio quality, with 24-bit processing and delay precision down to 0.01 ms. With the ability to provide unity gain up to a maximum input level of 24 dBu, the unit can be used with standard high-impedance devices or in a mixed environment using 600  $\Omega$  equipment. LEDs on the front panel indicate signal presence and alert when the signal is nearing the maximum input level.

## Features

Two distinct modes of operation: Distance & Video

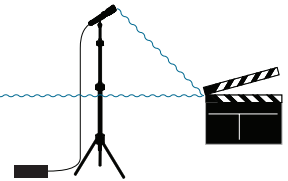
### Distance Mode

- Display in milliseconds, feet, or meters
- 2.00 to 999.99 ms Delay Range per channel
- 0.01 ms resolution



### Video Mode

- Display in frames per second or milliseconds
- Compatible with NTSC and PAL / SECAM frame rates
- 0.5 frame resolution

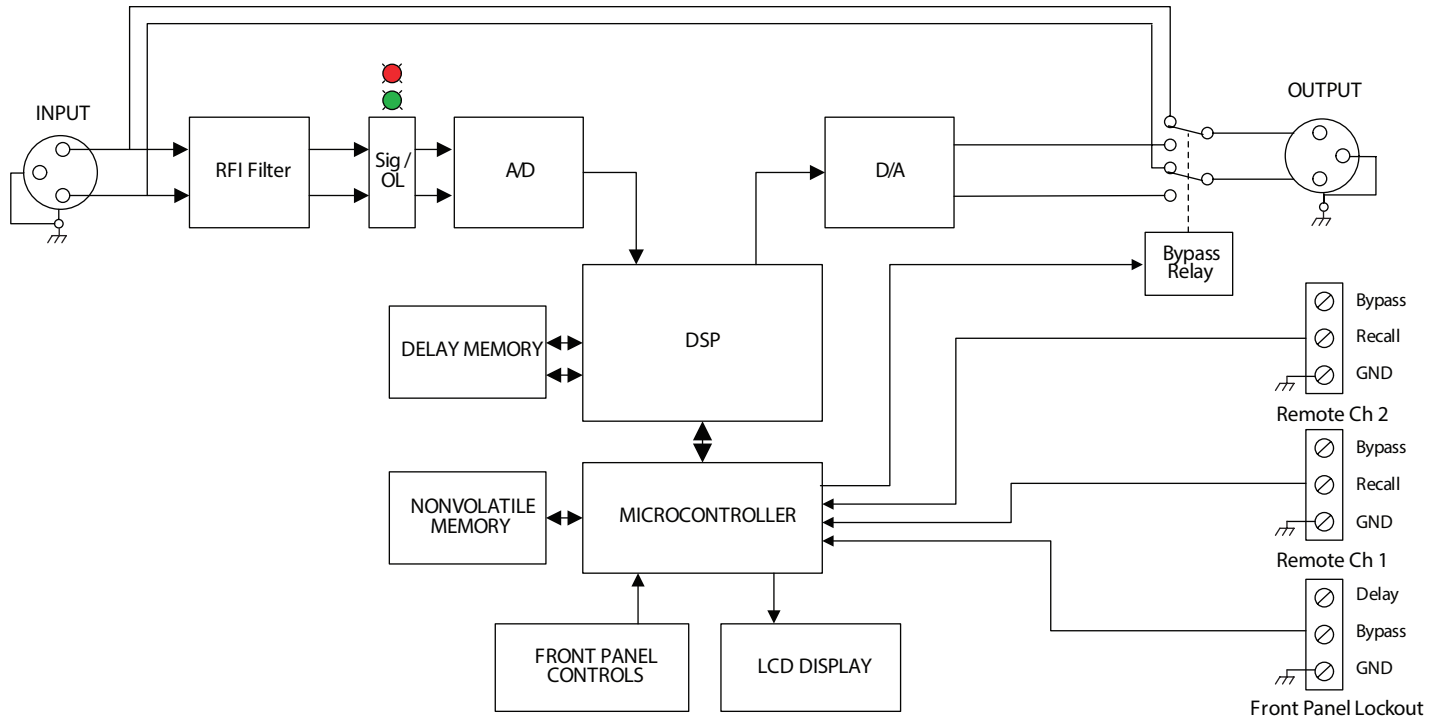


- Large backlit LCD display
- Two nonvolatile memories per channel for each alignment mode
- Remote memory recall port on rear
- Front panel lockout port on rear
- Failsafe bypass relay for each channel
- Internal universal power supply (100-240 VAC)

**Features and Specifications**

Parameter	Specification	Limit	Units	Conditions/Comments
Delay Range	2.00 to 999.99	1%	ms	
Distance Increment	0.01 and 1.00		ms	Each channel independent
Video Increment	0.5		frames	Each channel independent
.....NTSC (North America, Philippines, Japan)	23.976, 24, 29.97, 59.94, 60		fps	
.....PAL / SECAM (Europe, Australia, China, Brazil)	25.00 , 50		fps	
Sampling Frequency	50,000		Hz	
Data Conversion	24		bit	
Audio Connectors	XLR			Pin 2 (+)
Inputs: Type	Active balanced			
.....Impedance	20 k	1%	$\Omega$	Balanced, line to line
.....Max Level	24	$\pm 0.5$	dBu	
Outputs: Type	Active balanced			
.....Impedance	50	$\pm 10$	$\Omega$	Balanced, line to line
.....Max Level	24	+0/-0.6	dBu	
Output Relays	Yes			Auto-bypass on power loss
LED Thresholds: Clip	3 before converter overload	1	dB	+22 dBu @ 1 kHz
.....Signal Present	-47 below Clip LED	1	dB	-25 dBu @ 1 kHz
Frequency Response	20 Hz - 22 kHz	+0/-3	dB	+4 dBu, 20 Hz to 20 kHz
System Gain: High-Impedance Load	0	$\pm 0.5$	dB	Load = 10.0 k $\Omega$ balanced, +4 dBu, 20 Hz to 22 kHz
..... 600 $\Omega$ Load	0	+0/-1	dB	Load = 600 $\Omega$ balanced, +4 dBu, 20 Hz to 22 kHz
THD + Noise	0.006	$\pm 0.002$	%	+4 dBu, 20 Hz to 20 kHz, 30 kHz BW
Signal-to-Noise Ratio	86	$\pm 2$	dB	+4 dBu, 20 Hz to 20 kHz
Dynamic Range	108	$\pm 1$	dB	+24 dBu, 20 Hz to 20 kHz, A-weighted
Crosstalk	-90		dB	+4 dBu, 20 Hz to 20 kHz
Propagation Delay	2.00	1%	msec	Bypass off
Power Supply Requirement	100 to 240 VAC, 50/60 Hz			7 W
Unit: Conformity	CE, FCC, cULus			
Unit: Construction	All Steel			
.....Size	1.75"H x 19"W x 5.25"D (1U)			(4.4 cm x 48.3 cm x 13.3 cm)
.....Weight	4 lb			(1.8 kg)
Shipping: Size	4.25" x 20.3" x 13.75"			(11 cm x 52 cm x 35 cm)
.....Weight	10 lb			(4.5 kg)
<i>Note: 0 dBu = 0.775 Vrms</i>				

**AD22S Block Diagram (both channels identical)**



**Application Information**

**DISTANCE MODE**

There's more than one way to view your time setting. If you're tired of looking at milliseconds, the delay setting can also be viewed in terms relative to distance by changing the displayed units to feet or meters and by selecting the ambient temperature in either °C or °F. The AD22S calculates the precise environmental delay by using the relationship of air pressure and temperature to the speed of sound.

**VIDEO MODE**

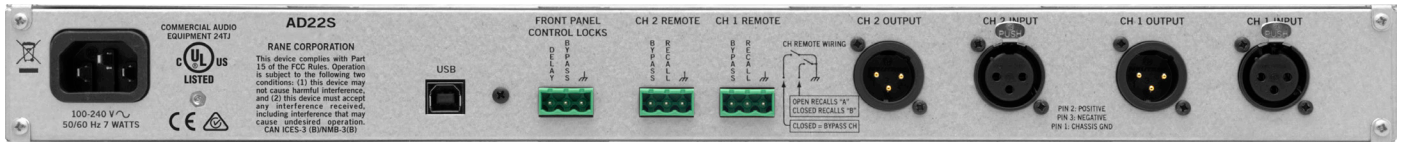
The AD22S is an effective solution to the problem of aligning audio with video in broadcast. Because of the latency involved in processing video streams, timing offset accumulates that can run as high as several frames or lead to noticeable synchronization issues. While in Video mode, the AD22S displays the delay time in the precise number of frames calculated for your current format and frame rate. You may choose from a selection of the most

common frame rates to match your work situation and environment. As you adjust the number of frames needed to synchronize the audio, the AD22S calculates the delay to match exactly what you need.

**REMOTE RECALL**

In some situations it may be necessary to recall a stored setting or enable channel bypass from a location other than where the AD22S is located. Have a room divider wall? You can install a switch to select between the two room settings automatically when the wall is moved. Does the delay for your outdoor speaker array change with the temperature? Wire up a switch to change from a memory setting adjusted for one temperature to one saved for the other when the weather warms up. For these reasons we have provided remote recall connections on the rear of the unit that can be wired to standard switches installed in any other location.

## Rear Panel



## Architectural Specifications

The digital audio delay unit shall be a single rack space, balanced two-input, two-output configuration. The delay adjustment range shall be from 2.00 to 999.99 ms, adjustable in 0.01 ms increments via increment / decrement pushbuttons, in 10  $\mu$ s or 1 ms intervals. Additionally, the values shall be selectable in terms of distance in feet or meters, as well as in frames for all common NTSC and PAL / SECAM frame rates.

A 40x2 backlit character LCD shall indicate current delay settings and provide cursor controls for selecting and setting the delay values and configuration parameters, including temperature, frame rate, and stored memory values. Bypass status, signal / overload presence and mode of operation shall be indicated with individual indicators.

Terminals on the rear panel shall allow remote disabling of the front panel controls and bypass switches. Additional terminals shall provide access for remote switches to recall memory settings.

The inputs and outputs shall be active balanced with XLR connectors, and include switchable fail-safe output relays on each channel that automatically enable in the event of power failure. RFI filters shall be provided.

The unit shall be capable of operation by means of its own built-in universal power supply operating at 100-240 VAC and meet CE requirements. The unit shall be UL and cUL listed.

*The unit shall be a Rane Corporation AD22S.*

## References

1. Shaw, N. "Digital Delays, Parts One, Two & Three," *Sound & Communications*, vol. 39, nos. 3, 5 & 10, (March, May, & October 1993).
2. Bohn, D. "Environmental Effects on the Speed of Sound," *J. Audio Eng. Soc.*, vol. 36, pp. 223-231 (April 1988).

## Sound System Interconnection

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

Rane Technical Staff

**RaneNote 110**

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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) has issued a standards document for interconnection of pro audio equipment. It is AES48, titled "AES48-2005: AES standard on interconnections —Grounding and EMC practices — Shields of connectors in audio equipment containing active circuitry."

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 compat-

ible 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.

## The Absolute Best Right Way To Do It

The method specified by AES48 is to 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 Figure 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

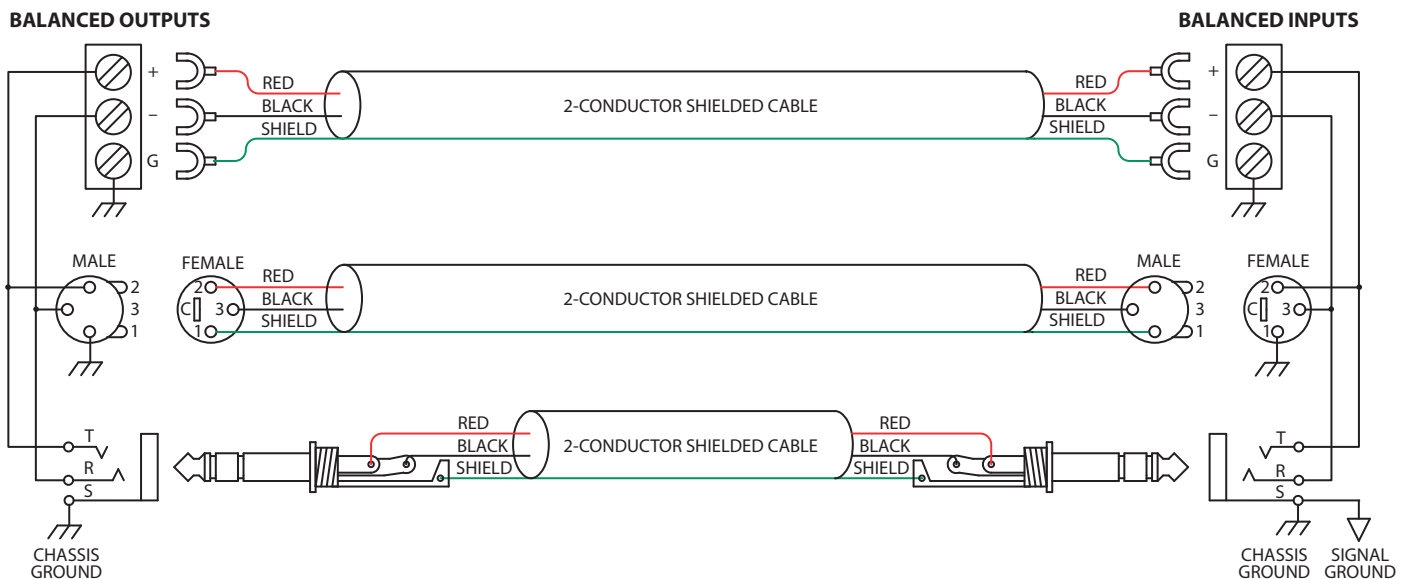


Figure 1a. The right way to do it.



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).

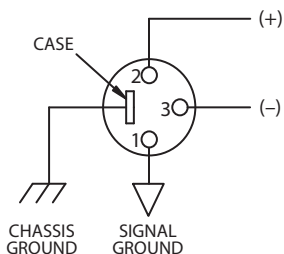
Since standard XLR cables come with their shields tied to pin 1 at each end (the shells are not tied, nor need be), this means equipment using 3-pin, XLR-type connectors *must tie pin 1 to the chassis* (usually called chassis ground) — not the audio signal ground as is most common.

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.

**COMMON (WRONG) PRACTICE**



**RECOMMENDED PRACTICE**

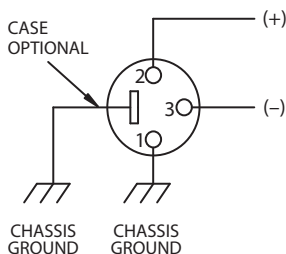


Figure 1b. Recommended practice.

**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.

**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 the receiving end. 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 ground-sending-end-only shield connection minimizes the possibility of high frequency (radio) interference since it prevents the shield from acting as an antenna to the next input. Many reduce this potential RF interference by providing an RF path through

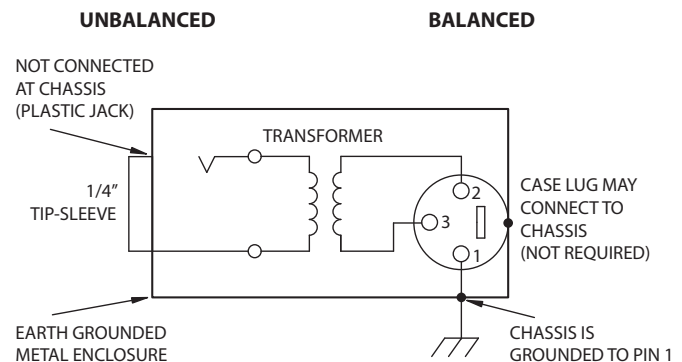


Figure 2. Transformer Isolation

a small capacitor (0.1 or 0.01 microfarad ceramic disc) connected from the lifted end of the shield to the chassis. (This is referred to as the “hybrid shield termination” where the sending end is bonded to the chassis and the receiving end is capacitively coupled. See Neutrik’s EMC-XLR for example.) 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 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 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 can’t do that, 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.

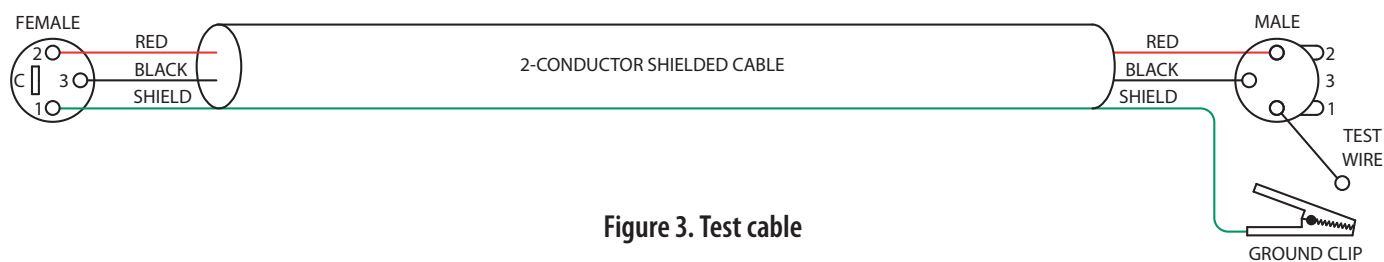


Figure 3. Test cable



## Floating, Pseudo, and Quasi-Balancing

During inspection, you may run across a ¼" 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.

## Winning the Wiring Wars

- Use balanced connections whenever possible, with the shield bonded to the metal chassis at both ends.
- 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 10 feet (3 m) in length. Lengths longer than this will amplify all the nasty side effects of unbalanced circuitry's ground loops.

## Summary

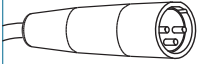

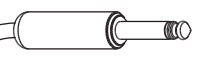


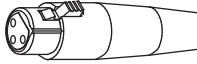
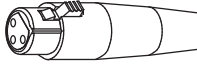
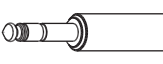
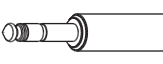
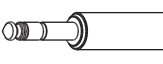
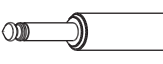


If you are unable to do things correctly (i.e. use fully balanced wiring with shields tied to the *chassis* at both ends, or transformer isolate all unbalanced signals from balanced signals) then there is no guarantee that a hum-free interconnect can be achieved, nor is there a definite scheme that will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

## References

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.
4. Phillip Giddings, *Audio System Design and Installation* (SAMS, Indiana, 1990).
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).
7. Cal Perkins, “Measurement Techniques for Debugging Electronic Systems and Their Instrumentation,” *The Proceedings of the 11th International AES Conference: Audio Test & Measurement*, Portland, OR, May 1992, pp. 82-92 (Audio Engineering Society, New York, 1992).
8. Macatee, *RaneNote*: “Grounding and Shielding Audio Devices,” Rane Corporation, 1994.
9. Philip Giddings, “Grounding and Shielding for Sound and Video,” *S&VC*, Sept. 20th, 1995.
10. AES48-2005: *AES standard on interconnections — Grounding and EMC practices — Shields of connectors in audio equipment containing active circuitry* (Audio Engineering Society, New York, 2005).

*Band-Aid* is a registered trademark of Johnson & Johnson

## To Input

From Output	To Input					
	 MALE BALANCED XLR	 ¼" BALANCED TRS (TIP-RING-SLEEVE)	 ¼" OR 3.5mm UNBALANCED TS (TIP-SLEEVE)	 UNBALANCED RCA	 BALANCED EUROBLOCK	
 FEMALE BALANCED XLR (NOT A TRANSFORMER, NOR A CROSS-COUPLED OUTPUT STAGE)	<b>1</b>	<b>2</b>	<b>3<sub>B</sub></b>	<b>4<sub>B</sub></b>	+ to + - to - SHIELD NC	
 FEMALE BALANCED XLR (EITHER A TRANSFORMER OR A CROSS-COUPLED OUTPUT STAGE)	<b>1</b>	<b>2</b>	<b>5</b>	<b>6</b>	+ to + - to - SHIELD NC	
 ¼" BALANCED TRS (NOT A TRANSFORMER, NOR A CROSS-COUPLED OUTPUT STAGE)	<b>7</b>	<b>8</b>	<b>9<sub>B</sub></b>	<b>10<sub>B</sub></b>	+ to + - to - SHIELD ONLY TO EUROBLOCK	
 ¼" BALANCED TRS (EITHER A TRANSFORMER OR A CROSS-COUPLED OUTPUT STAGE)	<b>7</b>	<b>8</b>	<b>11</b>	<b>12</b>	+ to + - to - SHIELD NC	
 ¼" FLOATING UNBALANCED TRS (TIP-RING-SLEEVE) (SLEEVE IN UNIT = NC)	<b>21<sub>A</sub></b>	<b>22<sub>A</sub></b>	<b>11</b>	<b>12</b>	+ to + - to - GROUND to GROUND	
 ¼" OR 3.5 mm UNBALANCED TS (TIP-SLEEVE)	<b>13</b>	<b>14</b>	<b>15<sub>A</sub></b>	<b>16<sub>A</sub></b>	<b>23</b>	
 UNBALANCED RCA (TIP-SLEEVE)	<b>17</b>	<b>18</b>	<b>19<sub>A</sub></b>	<b>20<sub>A</sub></b>	<b>23</b>	
 BALANCED EUROBLOCK	+ to + - to - SHIELD ONLY TO XLR PIN 1	+ to + - to - SHIELD ONLY TO TRS SLEEVE	<b>24</b>	<b>24</b>	+ to + - to - GROUND to GROUND	

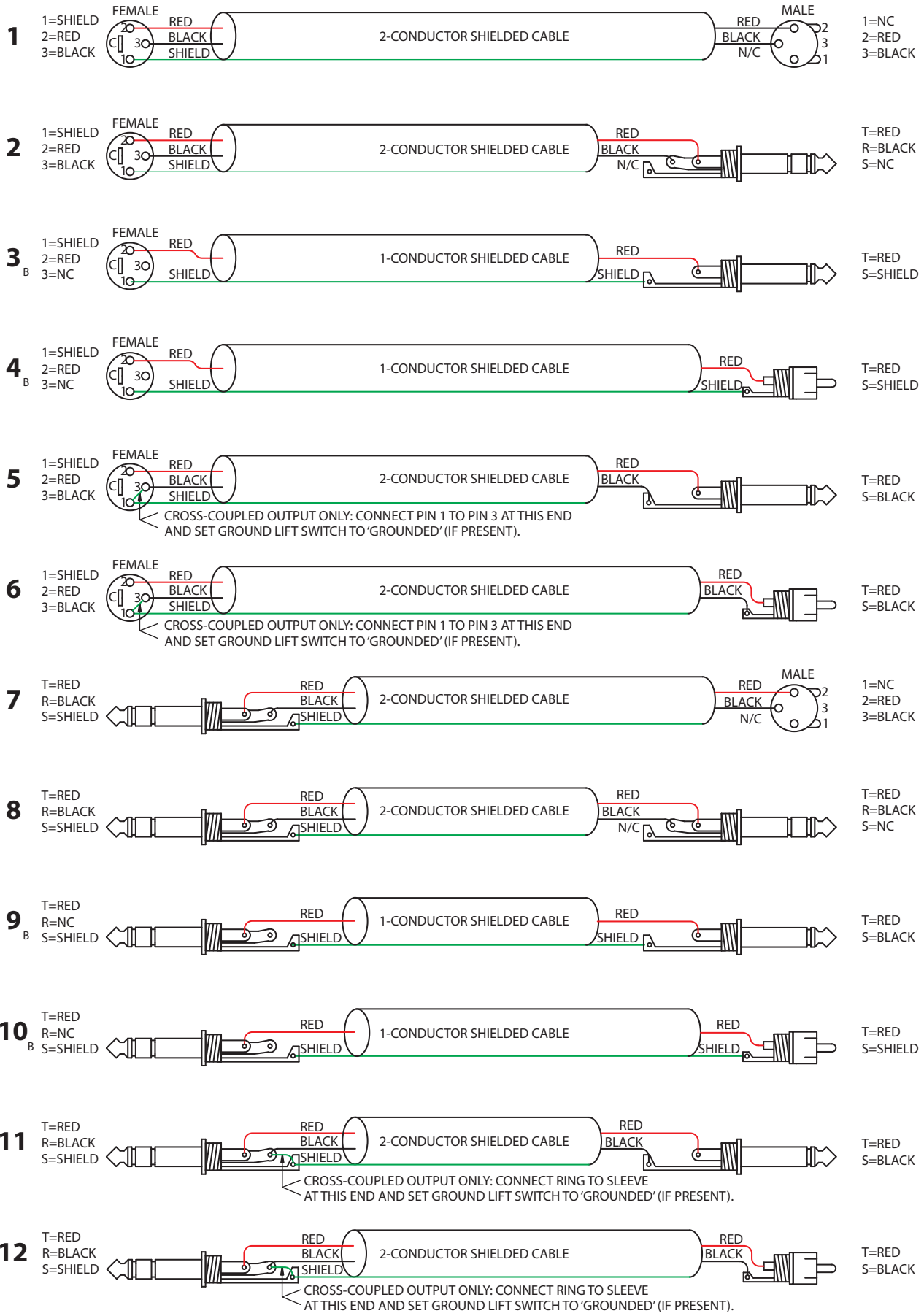
**Figure 4. Interconnect chart for locating correct cable assemblies on the following pages.**

Note: (A) This configuration uses an "off-the-shelf" cable.

Note: (B) This configuration causes a 6 dB signal loss. Compensate by "turning the system up" 6 dB.

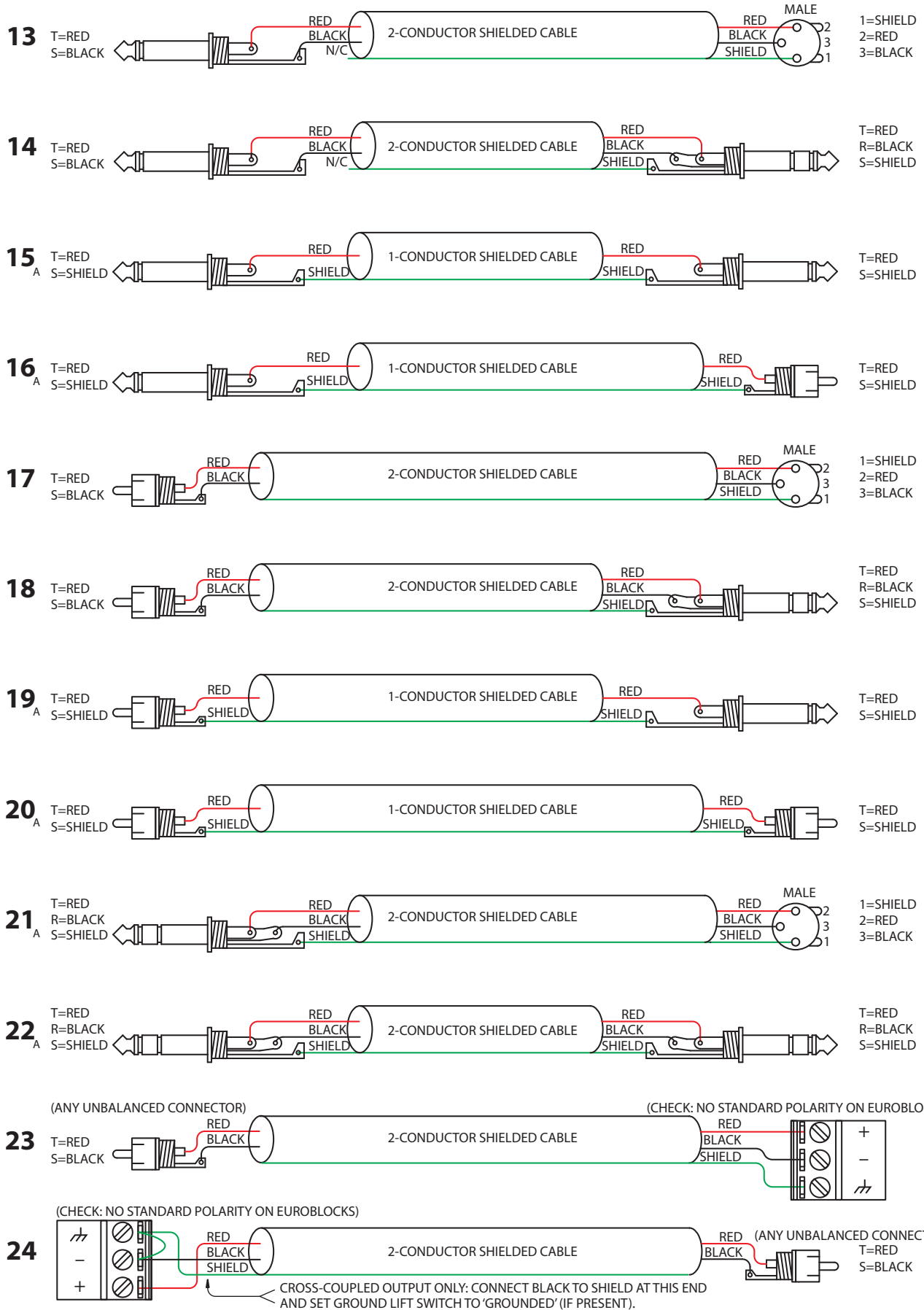
# From Output

# To Input



# From Output

# To Input





## **FACTORY AUTHORIZED SERVICE**

Your unit may someday need to be serviced by the Rane Factory if you live in the USA. International customers should contact your dealer or distributor for service. You must call the Rane factory before shipping. Please do not return your unit to Rane without prior authorization.

Rane Corporation

To obtain service or a Return Authorization in the USA, please phone 425-355-6000

or Fax 425-347-7757

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**NOTICE!** You must complete and return the warranty card or register your product online to extend the Warranty from 2 years to 3 years!

TO VALIDATE YOUR EXTENDED WARRANTY: Use the postcard that came in the box with your unit, or go to *www.rane.com* and click on **New Product Registration**. Fill out the warranty completely, being sure to include the model and serial number of the unit since this is how warranties are tracked. If your Rane product was purchased in the U.S.A., mail the completed card or register online with to Rane Corporation within 10 days from the date of purchase. **If you purchased the product outside the U.S.A. you must file your warranty registration with the Rane Distributor in that country.** It is advised that you keep your bill of sale as proof of purchase, should any difficulties arise concerning the registration of the warranty card. **NOTICE: IT IS NOT NECESSARY TO REGISTER IN ORDER TO RECEIVE RANE CORPORATION'S STANDARD TWO YEAR LIMITED WARRANTY.**

WARRANTY REGISTRATION is made and tracked by MODEL AND SERIAL NUMBERS ONLY, not by the purchaser's or owner's name. Therefore any warranty correspondence or inquires **MUST** include the model and serial number of the product in question. Be sure to fill in the model and serial number in the space provided below and keep this in a safe place for future reference.

WARRANTY SERVICE **MUST BE PERFORMED ONLY BY AN AUTHORIZED RANE SERVICE FACILITY LOCATED IN THE COUNTRY WHERE THE UNIT WAS PURCHASED, OR (if product was purchased in the U.S.) AT THE RANE FACTORY IN THE U.S..** If the product is being sent to Rane for repair, please call the factory for a Return Authorization number. We recommend advance notice be given to the repair facility to avoid possible needless shipment in case the problem can be solved over the phone. **UNAUTHORIZED SERVICE PERFORMED ON ANY RANE PRODUCT WILL VOID ITS EXISTING FACTORY WARRANTY.**

FACTORY SERVICE: If you wish your Rane product to be serviced at the factory, it must be shipped **FULLY INSURED, IN THE ORIGINAL PACKING OR EQUIVALENT.** This warranty will **NOT** cover repairs on products damaged through improper packaging. If possible, avoid sending products through the mail. Be sure to include in the package:

1. Complete return street shipping address (P.O. Box numbers are **NOT** acceptable).
2. A detailed description of any problems experienced, including the make and model numbers of any other system equipment.
3. Remote power supply, if applicable.

Repaired products purchased in the U.S. will be returned prepaid freight via the same method they were sent to Rane. Products purchased in the U.S., but sent to the factory from outside the U.S. **MUST** include return freight funds, and the sender is fully responsible for all customs procedures, duties, tariffs and deposits.

In order to qualify for Rane's one year extended warranty (for a total of 3 years parts and labor), the warranty must be completely filled out and sent to us immediately. Valid in USA only.

**We recommend you write your serial number here in your owners manual and on your sales receipt for your records.**

**SERIAL NUMBER:** \_\_\_\_\_ **PURCHASE DATE:** \_\_\_\_\_

# Declaration of Conformity

## Application of Council Directive(s):

2001/95/EC  
2012/19/EU  
2004/108/EC  
2006/95/EC  
2011/65/EU

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

EN60065: 2002/A1:2006/A11:2008/A2:2010/A12:2011  
EN55103-1:2009  
EN55103-2:2009  
EN50581:2012  
ENVIRONMENT E2  
CE MARK FIRST AFFIXED IN 2009  
SERIAL NUMBERS 900000 - 999999

## Manufacturer:

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**10802 47th Avenue West**  
**Mukilteo WA 98275-5000 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 2006/95/EC, and Electromagnetic Compatibility (EMC) directive 2004/108/EC. 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. This declaration of conformity is issued under the sole responsibility of Rane Corporation.

## Type of Equipment: Professional Audio Signal Processing

**Brand:** Rane

**Model:** AD22S

## Immunity Results:

THD+N: 4 dBu, 400 Hz, BW = 20 Hz - 20 kHz

### Test Description

### Specification

### Conditions

#### RF Electromagnetic Fields Immunity

80 MHz - 2000 MHz, 1 kHz AM, 80% depth, 3V/m

< -85 dB

80 MHz - 2000 MHz

#### Conducted RF Disturbances Immunity

150 kHz - 80 MHz, 1 kHz AM, 80% depth, 3V RMS

< -85 dB

Power Lines

< -85 dB

Signal Lines

#### Magnetic Fields Immunity

50 Hz - 10 kHz, 3.0 - 0.3 A/m

< -85 dB

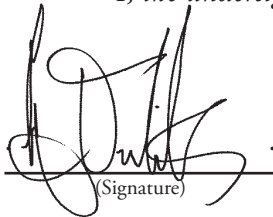
#### Common Mode Immunity:

50 Hz - 10 kHz, -20 dBu

Bandpass re: 4 dBu, 1/3-octave

< -74 dB

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



(Signature)

**Greg Frederick**

(Full Name)

**Compliance Engineer**

(Position)

**February 4, 2009**

(Date)

**Mukilteo WA, USA**

(Place)

# AD22S

AUDIO DELAY

