Method Not Madness

Correctly troubleshooting audio interfaces

By Bill Whitlock

Previously, we've looked at how unbalanced audio interfaces work, as well as how grounding-related noise can actually couple into the signal path. Of course, under fortuitous conditions, audio systems may be acceptably quiet in spite of poor techniques.

But physics will ultimately rule and noises may later appear for no apparent reason – remember, noises that disappear by themselves also tend to re-appear by themselves!

Most systems consist of more than two pieces of interconnected equipment, so there are multiple signal interconnection cables. When there's a noise problem, figuring out which interface is the culprit can be a daunting and time-consuming task. Troubleshooting with a logical, methodical approach can save both time and sanity.

Perhaps the most important aspect of troubleshooting is how one thinks about the problem:

- Don't fall into the trap of thinking something can't be the problem just because you've always done it that way. Remember, things that "can't go wrong" do!
- Don't start by changing things. Because many problems reveal themselves if we just gather enough clues, gather as much information as possible before you change anything.
- Ask questions! My favorite troubleshooting guru, Bob Pease, suggests these basics: Did it ever work right? What symptoms tell you it's not working right? When did it start working badly or stop working? What other symptoms showed up just before, just after, or at the same time? (*Reference 1*)
- Be alert to clues from the equipment itself. Operation of the equipment's controls, along with some simple logic, can provide very valuable clues. For example, if the noise is unaffected by the setting of a volume control or selector, logic dictates that it must be entering the signal path *after* that control. If the noise can be eliminated by turning the volume down or selecting another input, it must be entering the signal path before that control.
- Write everything down — less than perfect memory can waste a lot of time!
- Sketch a block diagram of the system! (**Figure 1**) Show all signal interconnecting cables, including digital and RF, and indicate their approximate length. Stereo pairs generally can be indicated with a single line. Note pieces of equipment grounded by either a three-prong power plug or any other ground connection such as for cable TV or a DSS dish. Mark any balanced inputs or outputs. (We'll talk about proper transitions between balanced and unbalanced in the future.)

As a general rule, and unless clues suggest otherwise, always begin testing interfaces at the inputs to the power amplifiers (or powered loudspeakers) and sequentially test interfaces backward toward the signal sources.

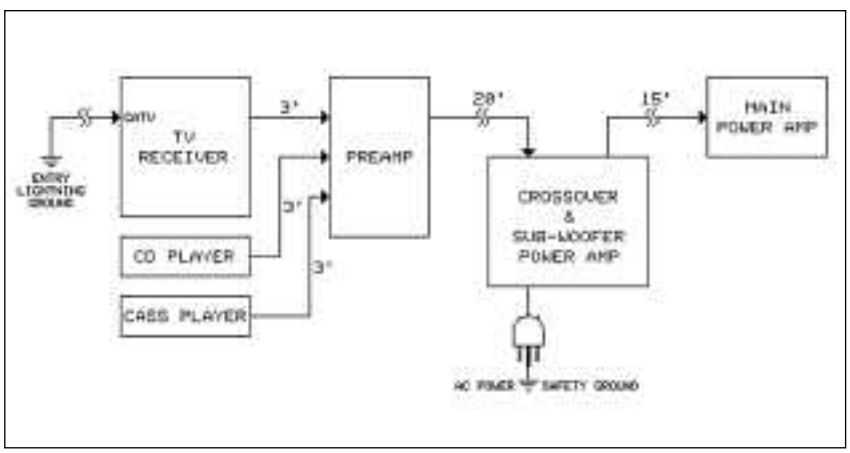


Figure 1: Be sure to show all signal interconnecting cables, and note any pieces of equipment grounded by either a three-prong power plug or any other ground connection.

THE DUMMY TEST

Simple test adapters or "dummies" allow each interface to be tested in the system without any additional instruments. Temporarily placing the dummies at strategic locations in the interface reveals not only the exact location of the noise coupling but also precise information about the nature of the coupling.

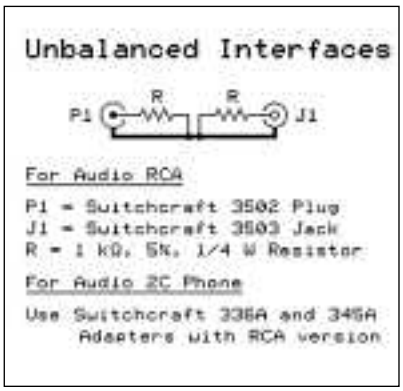
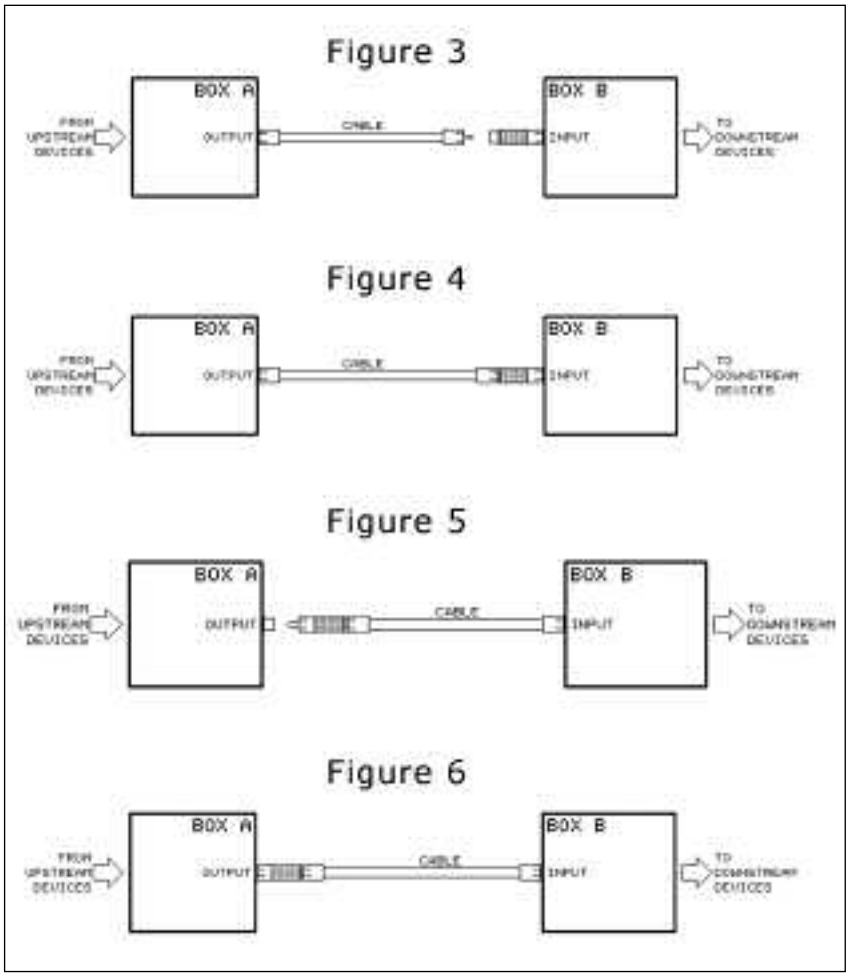


Figure 2: Be smart by using test "dummies" for unbalanced interfaces.



The tests can specifically identify:

• Common-impedance coupling in unbalanced cables (the most frequent problem by far).

• Induction of noise into the interconnect cable itself by nearby magnetic or electric fields. Or…

• Common-impedance coupling inside poorly designed equipment (also called the "pin 1 problem").

Test dummies for unbalanced interfaces are made from standard connectors wired as shown in **Figure 2**. Because they don't pass signal, make sure dummies are clearly marked so they aren't accidentally left in a system.

Also be very careful not to damage speakers or ears as cables are disconnected and re-connected! The surest way to avoid this problem is to turn off the power amplifier(s) before reconfiguring cables for each test step.

Each signal interface is tested using the following four-step procedure:

Step 1: Unplug the cable from the input of Box B and plug in only the dummy. (**Figure 3**) Is the output quiet?

No – the problem is either in Box B or further downstream.

Yes – go to the next step.

Step 2: Leaving the dummy in place at the input of Box B, plug the cable into the dummy. (**Figure 4**) Is the output quiet?

No – Box B has an internal "pin 1 problem." The "hummer test" can confirm this. (*Reference 2*)

Yes – go to the next step.

Step 3: Remove the dummy and plug the cable into the input of Box B. Unplug the other end of the cable from Box A and plug it into the dummy. *Be sure the dummy doesn't touch anything conductive.* (**Figure 5**) Is the output quiet?

No – noise is being induced in the cable. Re-route it to avoid interfering fields.

Yes – go to the next step.

Step 4: Leaving the dummy in place on the cable, plug the dummy into the output of Box A. (**Figure 6**) Is the output quiet?

No – the problem is common-impedance coupling. Install an isolator in the signal path.

Yes – the noise must be coming from the output of Box A. Perform the test sequence at the next upstream interface (inputs to Box A).

Now that we know what the problem is and which interface is afflicted, how do we correct it without degrading audio performance or creating a safety hazard? We'll tackle this next time. ■

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Reference 1: Robert A. Pease, *Troubleshooting Analog Circuits*, Butterworth-Heinemann, 1991.

Reference 2: Jensen Transformers, *Build a "Hummer" to Help Find "Pin 1" Ground Problems*, Application Schematic AS032, download at http://www.jensentransformers.com/as/as032.pdf.