

## Technical Bulletin

### No: 130 – RFI Troubleshooting

**Model:** RS-Series and Millenium                      **No:** 130  
**Subject:** RFI Troubleshooting                      **Date:** 02/17/2000  
**Symptom:** Noticeable buzz and or some detected audio RFI in high AM & FM Radio Frequency environments.  
**Solution:** Any one or more of the following shields, capacitor, or ferrite choke by-pass options below:

Note: The elimination of stray Radio Frequency Interference (RFI) can be more of an art-form than science. Therefore, it may require experimentation with various combinations of the following procedures to eliminate or adequately reduce the interference.

**Procedure:** Here are some suggestions on places to start

1. Begin by isolating the source of the interference. Disconnect the audio inputs, outputs and monitor feeds from the console. Since microphone channels are high gain they are a likely place for RFI to appear. Likewise the monitor inputs which are un-balanced tend to be likely locations for RFI susceptibility.
2. One at a time re-connect each input to the console and attempt to isolate the channel(s) through which the RFI has entered. Now, with the inputs once again removed, connect the outputs one by one to determine if the RFI has made its path through the output network.
3. Once you have identified the offending channel(s) try some of the following to see if it will reduce the interference:
  - One global solution may be to disconnect all input and output shields at the input and output connectors and connect them instead to a, user installed, buss bar (at least 16 gauge) across the interior-rear of the console pan. This buss bar should then connect to the large screw on the rear of the console power supply.
  - If the interference is on a Mic input, connect the shield on Mic cable to the case of the console instead of the ground on the channel input connector.



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- Install two clamp on ferrite filters over each microphone cable near the input connector to the console. Radio Shack part # 273-105 ferrite choke core should be suitable.
- Installing a .001 mfd disc capacitor between the + input terminal and the channel shield/ground. Then place another .001 mfd disc capacitor between the - input and the channel shield/ground .
- On RS Series consoles prior to 1995: If RFI appears to be entering through the output board try adding a 100pf capacitor between pins 5 and 6 on U31 and U32 and another 100pf capacitor between pins 7 and of U30. Open the ground trace on U30 pins 4 and 8 and add a 1 kOhm to ground.
- Whenever possible, try to have all studio power on the same leg of the incoming service and utilize the same ground reference.

Note: A special thanks to Mark W. Persons of M.W. Persons and Associates for his suggestions on RFI elimination in RS and Millenium series consoles.

#### **Information:** *Using Active Balanced Circuitry*

Here is a general discussion of how Active Balanced circuits Balanced lines have been used for many years and are in continuing use today because of their immunity to stray pickup. Induced signals appear on both sides of the balanced line. The receiving end of the balanced line responds only to the difference voltage between the lines, which is the desired signal. Induced signals are common to both and are balanced out.

Transformers have been the mainstay of balanced circuitry for decades. Unfortunately, transformers cause distortion and ringing, and are susceptible to magnetic flux pickup. Further, good quality audio transformers are very expensive.

The use of op-amp balanced circuitry has the advantage of transformers without the disadvantages. The only caveat is that



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careful wiring practices are more important with active balanced than with transformers.

Active balanced outputs and inputs use three wires: +, -, and ground. The + and - terminals are both driven and neither should ever be connected to ground. For best performance, a three-conductor shielded wire should be used. The third wire completes the ground circuit. The shield should be connected to the ground at one end of the wire only. If a two-wire shielded cable is used, it is important that a ground connection be made between the sending and receiving units. A ground circuit through equipment chassis or through three-prong AC cord ground is also acceptable.

Single-ended audio interconnections lack the interference immunity of balanced hook-ups. For the reason, keep unbalanced connections short, direct, and well separated from AC power wires. To drive a single-ended load from an active balanced source, use coaxial wire: + to center conductor and ground to shield, leaving the - output unconnected. To feed an active balanced input from a single-ended source, use coaxial wire, connecting the hot center conductor to +. Connect the shield to ground and put a jumper from ground to -.

When driving an active balanced input from a transformer balanced floating source, use two conductor shielded wire. Ground the shield at the source end. Establish good ground between the chassis either directly or through AC plug ground prongs. At the load, connect the + lead to the + input and the - lead to the - input. Put two 300 ohm resistors in series between the + input and the - input and connect their mid-point to the load ground. This correctly terminates the source output transformer for optimum frequency and transient response (freedom from ringing) and provides a low impedance return path for leakage and induced hum. If more than one active balanced load is to be placed across a floating balanced transformer source, install this resistive termination once only. From that location to the active balanced loads, run three-conductor shielded wire, shield continued from the sources chassis, + from +, - from -, and ground from the mid-point of the terminating resistors.

To drive a balanced floating transformer load from an active balanced source, use shielded wire. Connect the shield to source ground and leave the shield open at the load end. Connect + to + and - to -, and establish a good source ground to load chassis



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connection, either through a third wire in the interconnect cable or through chassis contact or AC cord third wire ground.

Interconnections between pieces of stereo equipment require doubling the connections described above without duplicating the ground connection. Between pieces of active balanced stereo equipment, then, 5 shielded conductors should be run.

When testing active balanced equipment with single ended test equipment, do not connect the - to test equipment ground. Most modern test equipment provides balanced inputs. In many dual-trace oscilloscopes, balanced signals may be displayed by running the two inputs in the “add” mode with one input switched to invert. To perform a test with single-ended equipment, + and - outputs must be tested independently and their results added. Testing only a single output results in a 6 dB loss in output level.

The active balanced equipment interconnection format makes possible state of the art fidelity. Careful attention to detail and conservative practice will be rewarded with outstanding flat frequency response, low distortion, and wide dynamic range.



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