THE BIG SOLDER JOINT

Sometimes in our high fidelity industry it seems like if you want to attract attention to a product or a listening experience, the best way to do it is to concoct a new bit of technical jargon or say that "the listening panel" decided this or that. Contractions and acronyms run rampant. One begins to feel like an outsider if he doesn't know what CD, DAD, THD. SID, TIM, AFC, LSI, VHP, MPX, IF, RF, or some other combination of the alphabet means. Confusion reigns for many if not all.

On the other hand, once in a while a statement is made that makes one stop short and think about how the statement compares with practical experience. One such statement recently overheard was made by a well respected and experienced recording engineer. He stated that loudspeaker leads must not be spliced by soldering two sections of lead together. He stated "soldered connections produce distortion". Further, "anyone" can hear the difference between a "soldered connection" and a mechanically "clamped connection".

At first though one might prefer to pooh-pooh the statement. After all, how many solder connections are there in the electronics between the microphone to recorder, and from the playback device through the amplifier to the speaker. Amplifiers have tens, hundreds, perhaps even thousands of solder connections. Power transistors have their chips soldered to their heat sinks internally. Loudspeakers have the voice coil leads soldered to other leads. Crossover networks have soldered connections. So why worry about soldered connections?

On the other hand, speaker leads might be special. Some feel the bigger the better, so maybe a little solder might introduce some kind of "impedance" or some such thing. Let's think about it.

First, to make a good solder joint, one is suppose to make a good mechanical connection. The wires to be joined are to be clean so solder can adhere. The wires are then soldered. Solder, made of tin and lead, has a much higher resistance than copper wire. The resistance is about 9 times as much for the same cross sections and length. It is hard to say how thick the solder is in a well made solder joint, but you can easily estimate that it most certainly is less than say three times the thickness of the paper this is written on, which would be $1/100^{th}$ of an inch. Therefore, the resistance of a solder joint joining two copper wires would be no more than the resistance of adding an additional lenght of copper wire $9/100^{th}$ of an inch long to the circuit. This sounds negligible.

But some might say, well, solder isn't like copper. The resistance might be non-linear, and this will cause distortion. We decided to test for non-linearity in solder.

There might be all kinds of solder joints, some bigger than others. We decided to make a solder joint that really had a lot of solder. We made the joint real long. Verrrrrry loooooong. We determined that 6 feet of #20 wire gauge Ersin 63/37 multicore wire solder measures 0.5 ohm. Therefore, we selected a length sixteen times as long, or 96 feet, to form an 8 ohm solder test resistor. This was used to represent a ridiculously huge "solder joint".

How do you test a "solder joint"? We used a McIntosh MC-502 power amplifier and Sound Technology 1700A Distortion Analyzer. First we tested the Sound Tech 1700A, oscillator output to analyzer input. The total harmonic distortion (THD) measured 0.0016% at 1 kHz, the residual limit for the instrument. Next, we fed the test signal through the MC-502 to an 8 ohm non-inductive dummy load. The THD measured the same, 0.0016%. We also tested the MC-502 into an open circuit and into 16 ohms with the same result, 0.0016%.

Next, we made a voltage divider of the 8 ohm "solder joint" 96 foot length of solder and the 8 ohm non-inductive load resistor. We fed the MC-502 into the divider, which gave a 16 ohm load to the amplifier, and placed the distortion analyzer across the 8 ohm non-inductive resistor. The output to the analyzer was attenuated to 1/2 (or by 6 dB) by the divider, so the analyzer had to be readjusted for "set level".

Surprise of surprises, the analyzer indicated 0.1% distortion! Someone is correct, solder is no good! But wait, what kind of distortion is it? An oscilloscope across the analyzer output might show. Viewing the scope quickly indicated the trouble. The "distortion" was our local AM station at 680 kHz being picked up by 96 feet of solder spread out about the lab bench.

To revise the "solder joint" we wound the 96 feet of solder on a plastic bobbin. Solder is bare so it was necessary to insulate the turns which was easily done by winding an insulated copper wire simultaneously with the solder, making a bifilar winding. The layers were insulated using masking tape. The finished coil looked a bit like a toroid coil 3 inches in diameter and 2 inches wide. The copper wire was connected to the end of the solder wire so that the current flowing in the solder was moving in the opposite direction to the current moving in the copper wire right next to it. This, of course, has the effect of cancelling the magnetic fields and cancelling the susceptibility of the coil to any radiated fields, such as that from the AM radio station. The new coiled "solder joint" was tested. This time, lo and behold, we measured 0.0016%.

If we had stopped with the first test, we might have concluded that the world is wrong and that solder is a "no-no". Testing further proves to us that solder is perfectly OK and suggests we must be careful how we view what we hear.

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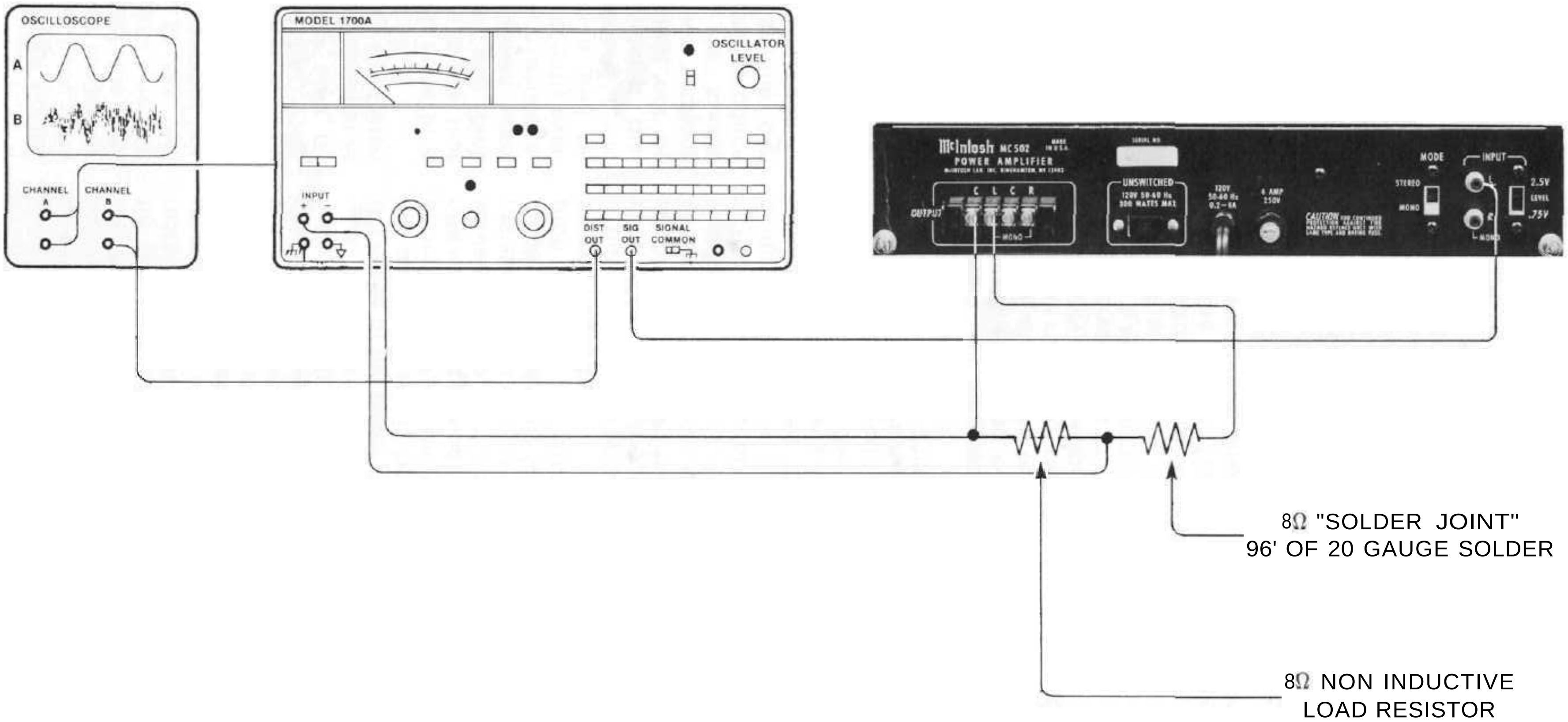

DISTORTION MEASURING TEST SET UP