Engineering News

ALTEC LANSING
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TECHNICAL LETTER NO. 171

70 VOLT LINE IMPEDANCE BRIDGE

The impedance of the pair of wires you attach to the output of the power amplifier in your sound system needs to be known accurately if today's standards for performance, longevity, and reliability are to be met.

There is evidence that, more often than not, the impedance of the line attached to the amplifier is too low. Why?

The following is a partial list of typical reasons:

1. Transformers are set at wattage taps that add up to a greater wattage than the amplifier can deliver.
2. Poor quality transformers cause an excessively reactive load.
3. Transformers are connected backwards.
4. Short or ground in the distribution line wiring (often the sound contractor is at the mercy of the installing electrical contractor).
5. Unauthorized bridge taps are made at either too low an impedance or without any transformer at all.

All Altec power amplifier specification sheets show the rated output impedance as well as the voltage at that impedance for full power output. The 1569A, for example, has the following output connections:

Impedance	Voltage at 80 Watts
62 Ω	70 Volts
16 Ω	36 Volts
8 Ω	25 Volts
4 Ω	18 Volts

This technical letter describes a simple, easily constructed impedance bridge that measures the total impedance in Ω. Figure 1 shows a schematic and parts list for the constructor. Figure 2 illustrates the point in the sound system circuit where the impedance bridge is connected.

Calibration of the Instrument

To calibrate your impedance bridge cut out the template on the rear sheet of this technical letter and paste under the knob on the variable 75 Ω resistor. For those who wish to draw their own, the divisions are 20° apart. This resistor is linear and covers 300° in its rotation. With the resistor now set completely counterclockwise, line up the pointer on the knob with zero on the template.

A further check, if desired, can be made by attaching a VOM to the resistor and seeing if the dial markings and the VOM agree.

Operating Instructions

An audio oscillator is connected to the input of the sound system power amplifier. (Be sure the power amplifier volume control is turned off.) The output of the sound system power amplifier is connected to the input terminals on the impedance bridge. The output of the impedance bridge is connected to the 70 Volt distribution line. (Note: This bridge can be used to measure any loudspeaker line within its range of 0 to 150 Ω but it is normally 70 Volt distribution lines that are most in need of measurement.

With the power amplifier volume control turned off the audio oscillator is set to deliver approximately one-tenth of a Volt output. This is usually at 1000 Hz though any frequency in the audio spectrum may be used.

When using the bridge at very low or very high audio frequencies, 50 Hz or 20 KHz, the reactance of some components may cause a very broad null which makes it difficult to determine an exact value. Therefore, 400 to 1000 Hz represents the most significant region because it is within this range that the greatest program power is developed. For this reason, mismatch is most critical in that region.

The impedance bridge is set to a reading remote from that calculated as correct for the line being measured. The range control on the impedance bridge can be set for either 0 to 75 Ω or 75 to 150 Ω through the use of SW_1 shown in Figure 1. The power amplifier volume control is then slowly brought up until at least a 3/4 full scale reading on the impedance bridge meter is observed. By rotating the variable resistor slowly through its range a null (a zero reading on the meter) will be obtained. Carefully tune both sides of the null in order to ascertain its exact position. Care must be exercised not to increase amplifier drive in an effort to view the null more sharply. It is very easy to exceed the power handling capabilities of the bridge components when dealing with high power amplifiers. Once a 3/4 scale reading is obtained at a value away from the null point the power amplifier volume control should not be increased while tuning the null.

The dial reading of the calibrated variable resistor on the bridge represents the impedance of the lines being measured. Readings higher than those represented by the specified amplifier impedance are fine, but your trouble shooting has just begun if the reading you obtain falls below the correct value. (In order to allow for variables, system changes are not mandatory until the reading falls -20% below that specified.)

Summary

Once this measurement has become an automatic part of your system checkout your good reputation will not be endangered because of the "mysterious" failures of transistor amplifiers. They will not tolerate a downward mismatch as long as a tube unit. Tubes don't like it either and distortion rapidly increases as well as frequent field replacement of tubes.

In addition to each new system you check with your impedance bridge, be sure that you use it to examine every "maintenance problem" system you have previously installed.

Appendix

The impedance of the amplifier being used can be calculated by $Z = \frac{E^2}{W}$. In the case of 70 Volt lines $E^2 = 5000$ and this figure is divided by the appropriate wattage rating. It can be seen that as the wattage rating grows larger the impedance value becomes smaller.

The impedance of a distribution line represents the total opposition of that line to the flow of alternating current. The impedance is the combination of the resistance of the line and the reactance it exhibits.

Reactance can either be capacitive (Xc) or inductive (X_L). In either case, reactance adds to the apparent resistance of distribution line and represents part of the load.

By Don Davis

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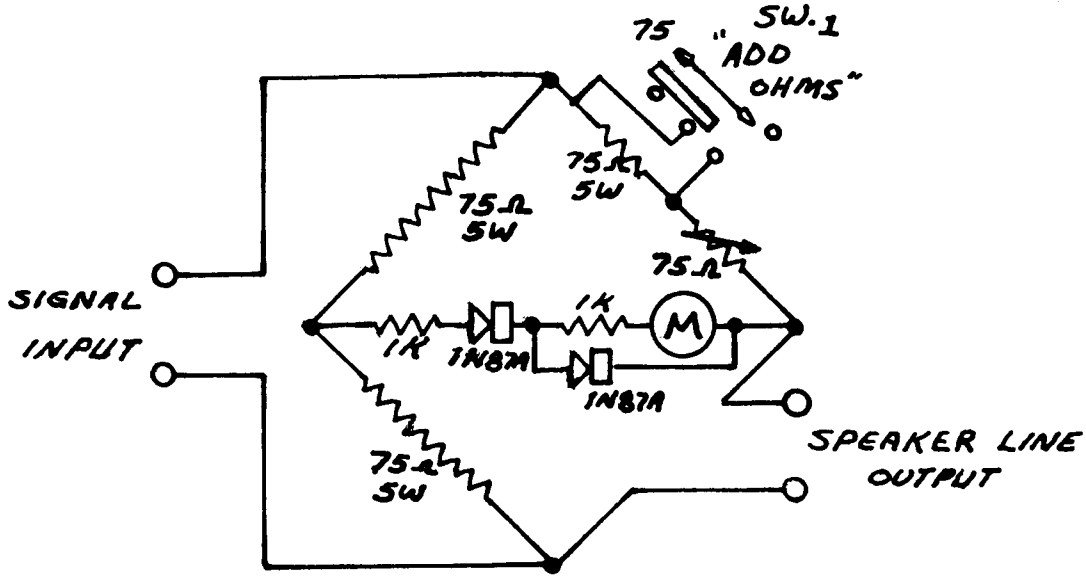
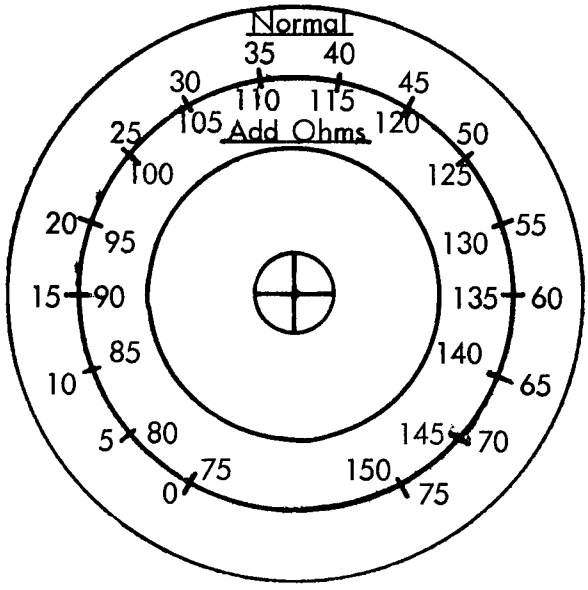


PARTS LIST

QUANTITY	DESCRIPTION	MANUFACTURER
1	Mini Box	Bud
1	Meter-Panel Mtg. 0-200 Microamp Movement	
4	Binding Posts	EBY #12
3	75 Ω ±5% 5 Watt Resistors	Ohmite - wire wound brown devils
2	1,000 Ω ±10% 1/2W Resistors	Ohmite - little devil
1	Slide Switch S.P.S.T.	Stackpole SS26
1	75 Ω, 4 Watt Potentiometer	Mallory M75PK
1	Pointer Knob	G.C. Electronics #24-562
2	IN87A Diodes	

Figure 1



Template

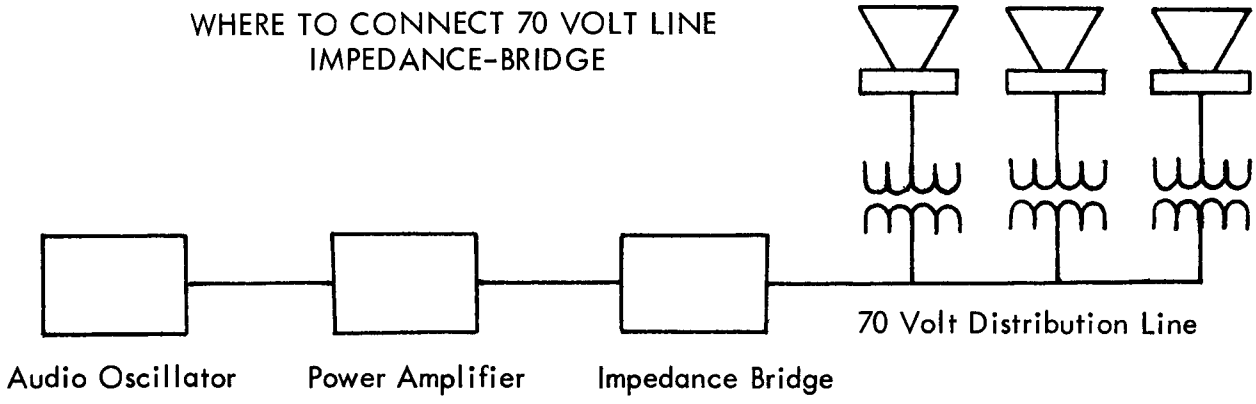


Figure 2