Audio-test accessory isolates and matches loads

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Connecting a 600Ω audio circuit to a 50 or 75Ω circuit or test instrument requires an impedance-matching circuit or, when isolation of the circuits is necessary, a transformer. Both approaches offer advantages and disadvantages. A conventional transformer can match impedances with low typical losses of 1.5 dB, provide dc isolation, and operate from either a balanced or an unbalanced, 600Ω primary circuit. A high-quality transformer's passband can accommodate an audio-frequency range of 300 Hz to 15 kHz with minimal amplitude variation. However, transformers that can match 600 to 50 or 75Ω may not be readily available or may command a cost premium.

A minimum-loss, fixed-value impedance-matching circuit, or pad, provides frequency-invariant audio-impedance transformation and can comprise as few as two resistors. Although a pad can provide useful impedance matching, it introduces a significant insertion loss of 14.8 dB for a 600-to-75Ω transformation or 16.6 dB for a 600-to-50Ω transformation, either of which might impose an unacceptable loss of dynamic range.

Part of a suite of test accessories, this low-cost, switchable, dual-impedance transformation circuit comprises a single conventional transformer and two minimum-loss pads (**Reference 1**). A single inexpensive, conventional transformer steps down the 600Ω primary input impedance to an intermediate impedance level of 100Ω (**Figure 1**). Switch S_1 selects a 100 to 50Ω or a 100 to 75Ω minimum-loss pad. Construction of the unit involves noncritical point-to-point wiring, although this design uses a Hammond 1590LB die-cast-aluminum box to provide shielding and a rugged enclosure to support three Amphenol (www.amphenolrf.com) RFX series BNC panel-mounted, insulated-frame input and output jacks. T_1 is a Mouser Electronics (www.mouser.com) 42TM031 audio transformer, and the resistors are 0.5W, metal-film units with ±1% tolerances. With quantity discounts, the overall bill-of-materials cost is less than $20.

To verify frequency response and

TABLE 1 INSERTION LOSS VERSUS FREQUENCY

Frequency (kHz)	Insertion loss (dB) 600 to 50Ω	Insertion loss (dB) 600 to 75Ω
0.1	11.7	8.7
0.3	10	7
0.5	9.5	6.7
1	9.2	6.5
2	9	6.3
5	8.9	6.1
10	8.8	6.1
20	8.8	6
50	8.9	6.1
100	9.5	6.7

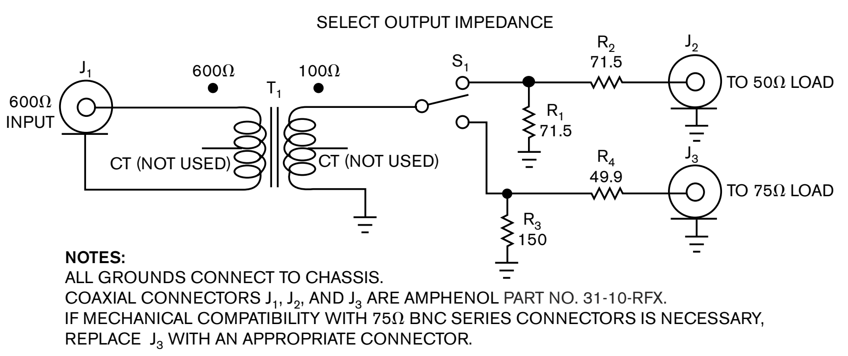

Figure 1 A handful of passive components creates a handy test fixture for matching impedances in audio-test circuits.

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attenuation in a 600Ω test setup, connect two identical units back to back through their 50 or 75Ω terminals. You obtain the measured data (**Table 1**) for a single unit by halving the 600-to-600Ω transmission-loss measurements.

Calculated insertion loss for the 100 to 50Ω minimum-loss pad is 7.7 dB, and insertion loss for the 100 to 75Ω minimum-loss pad is 4.8 dB. Subtracting these values from the measured losses indicates that the transformer contributes a midband loss of 1.3 to 1.5 dB. Insertion loss due to stray coupling from the selected output port to an unused output exceeds 40 dB. Combining a conventional transformer with two minimum-loss pads takes advantage of the best of both techniques.

The low-cost transformer contributes moderate insertion losses and provides dc isolation and good frequency response. In addition, the transformer's low-frequency roll-off helps reduce 60-Hz hum and low-frequency noise. The electrically isolated input jack allows connection of the transformer's input to balanced or grounded 600Ω sources. **EDN**

REFERENCE

1 Kurzrok, Richard M, "Simple Lab-Built Test Accessories for RF, IF, Baseband, and Audio," *High Frequency Electronics*, May 2003, pg 60.