EDWARD M. LONG

TDL RTL 1 SPEAKER

Transducer Design, Ltd. (TDL), based in Buckinghamshire, England, specializes in making transmission-line speaker systems. The company, founded in 1969, is now headed by John Wright, a well-known designer of such speakers. TDL makes quarter-wave reflex transmission-line speakers, such as the RTL 1, and larger, half-wave models.

Like infinite-baffle and acoustic-suspension designs, half-wave transmission-line speakers are configured to absorb the output from the rear of the woofer cone. The bass driver's rear wave is directed through a tunnel whose length equals a half wavelength of the lowest frequency to be reproduced. The tunnel, which often is tapered, is usually folded and filled with an absorbent material, such as long-fiber wool. In quarter-wave reflex transmission lines, the tunnel's length is one-fourth the wavelength of the lowest frequency to be reproduced. The back wave is not completely absorbed, emerging from the tunnel to reinforce the woofer's front wave.

TRANSMISSION-LINE SPEAKERS CAN PROVIDE GOOD LOW BASS FROM SMALL WOOFERS.

Several advantages are claimed for transmission-line systems. They are said to produce good output at very low bass frequencies. They enable the use of small woofers, whose output can thus extend into the mid frequencies. And their enclosures are inherently very well braced by the tunnels inside them.

The RTL 1 is a two-way system, with a 1-inch dome tweeter and 6-inch cone woofer made by TDL. It is designed to be placed on a bookshelf or mounted on a stand. The enclosure (including the partitions forming the transmission-line tunnel) is made of medium-density fiberboard, ⅝ inch thick except for the ¾-inch-thick front baffle, and is finished in black wood-grain vinyl. A small amount of Dacron is behind the tweeter, but there is no other absorbing material inside the cabinet except at the tunnel's exit. That exit, at the bottom front, is divided into two openings with open-cell foam grilles. The foam is intended to help limit the woofer's excursion at very low frequencies by restricting airflow in and out of the openings. The front of the enclosure, except for the tunnel openings, is covered by a grille of acoustically transparent black stretch cloth with a snap-off plastic frame.

The input terminals are near the top of the rear panel. Five-way binding posts are provided for the crossover's high- and low-pass filters, which are normally connected by gold-plated metal straps. By removing the straps you can bi-wire or biamplify the RTL 1; this might be advantageous sometimes, such as when long cable runs are required. The red and black posts of each pair are spaced ¾ inch apart to accept standard dual-banana plugs; the two pairs are on shelves, angled at 45°, for easy access.

Rated Frequency Range: 40 Hz to 20 kHz.
Rated Sensitivity: 87 dB SPL at 1 meter, 2.83 V rms applied.
Rated Impedance: 8 ohms.
Recommended Amplifier Power: 20 to 80 watts.
Dimensions: 16⅜ in. H x 7⅞ in. W x 8⅝ in. D (41.5 cm x 20 cm x 22 cm).
Weight: 13½ lbs. (6.1 kg) each.
Price: $499 per pair.
Company Address: c/o Melody Audio, 1940 Blake St., Suite 101, Denver, Colo. 80202; 303/295-3100.
For literature, circle No. 94

Photos: Michael Groen

The crossover is fairly simple and straightforward. The tweeter is fed through a second-order (12-dB/octave) high-pass filter. This consists of a 1.8-microfarad capacitor in series with a 2.7-ohm resistor (which attenuates the tweeter's output to match the woofer's) plus a 0.27-millihenry inductor across the tweeter terminals. The low-pass filter, which feeds the woofer, is a first-order (6-dB/octave) type consisting of a single 0.72-millihenry inductor.

Measurements

Figure 1 shows the RTL 1's frequency response. (The microphone was 1 meter away and at a point between the speaker's tweeter and woofer. I placed the speaker and the mike away from any reflecting surfaces.) The acoustical crossover is not easy to determine, but it appears to be at around 2.5 kHz. The tweeter response is very uniform, especially with the grille removed. A sag in the woofer and tweeter outputs at about 2.5 kHz causes a dip in the overall response. The RTL 1's response is smoother without the grille, but since most people will listen with it on, I left it in place for all other tests.

THE RTL 1 SHOULD BE AN EASY LOAD FOR ANY POWER AMPLIFIER.

The drivers' phase responses, seen in Fig. 2, are nearly identical between 3 and 6 kHz. The match at 3 kHz helps the woofer and tweeter outputs to combine, as they should, to produce a total output 6 dB greater than either's output alone, as seen in Fig. 1. Above 3 kHz, however, the match doesn't really matter, as the woofer's output rolls off steeply in this region. At around 2 kHz, the drivers' outputs are about 100° apart (equivalent to about 139 microseconds, or a path-length difference of 1.88 inches). At 2.5 kHz, the apparent acoustical crossover frequency, the phase difference is only 20° (equivalent to 22 microseconds, or 0.3 inch).

The RTL 1's impedance (Fig. 3) reaches a minimum of 6.3 ohms at about 5 kHz and a maximum of 15 ohms at around 1.5 kHz, so this speaker should be an easy load for any power amplifier. The woofer is tuned by the reflex transmission-line tunnel to 53.5 Hz, as indicated by the dip in the impedance at this frequency.

For Fig. 4, I measured the RTL 1's output and distortion at sound pressure levels of 90 and 100 dB. (The speaker and microphone were on the ground, increasing levels by 6 dB over the other graphs in this report.) The second-harmonic distortion for 90-dB output is greatest at about 450 Hz, where it reaches 4.5%; at 130 Hz, it's 3.5%. The third harmonic for 90 dB SPL is a mere 0.63% at 450 Hz and 1.2% at 130 Hz. At 100 dB, second-harmonic distortion is 10% at 450 Hz and 2.5% at 130 Hz; third-harmonic distortion is just 1.6% at 450 Hz and 0.9% at 130 Hz. Except for the 10% second-harmonic distortion at 100 dB SPL, the RTL 1's distortion is remarkably low, considering that the woofer is a 6-inch driver. Furthermore, even-order harmonics are usually perceived as being mellow and, therefore, less objectionable than third-harmonic and other odd-order distortion, which tend to sound rather harsh. In speakers, even-order harmonic distortion is caused by asymmetry of a driver's diaphragm motion or its motor system, whereas odd-order harmonic distortion is caused by symmetrical limiting of the output.

Figure 5 shows on- and off-axis responses. With the speaker in its recommended position, upright and its tweeter above its woofer (Fig. 5A), the responses are reasonably well behaved except between 2.5 and 5 kHz. Response with the RTL 1 lying on its side is not as good, as you can see in Fig. 5B (measured from the woofer end) and Fig. 5C (from the tweeter end). I don't recommend placing the RTL 1 on its side.

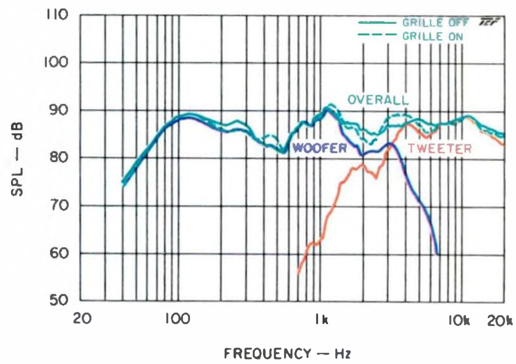


Fig. 1—Frequency response.

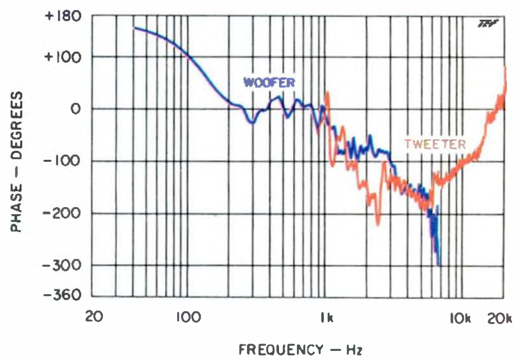


Fig. 2—Phase response.

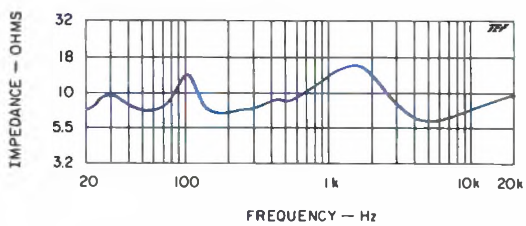


Fig. 3—Impedance magnitude.

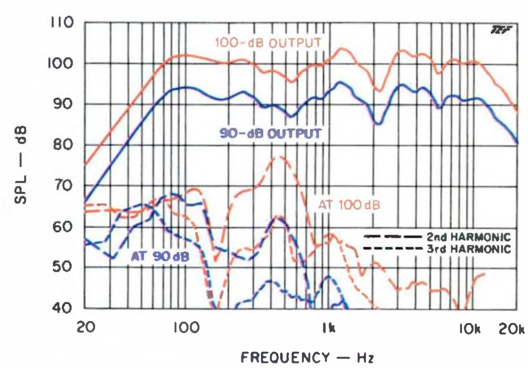
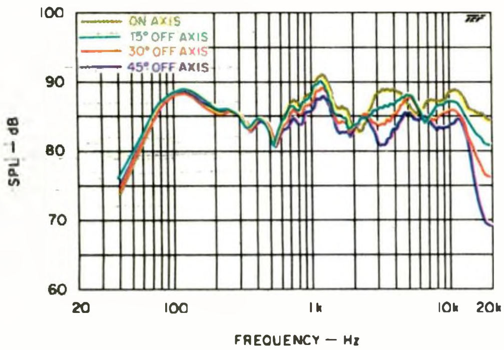
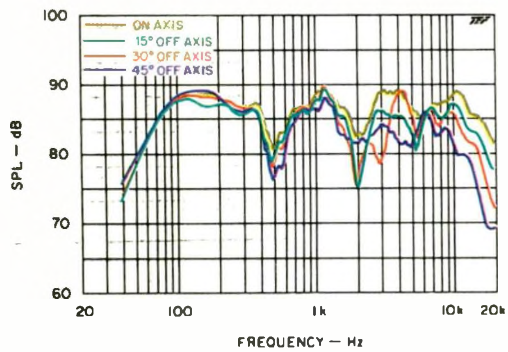


Fig. 4—Ground-plane frequency response and second- and third-harmonic distortion.



A



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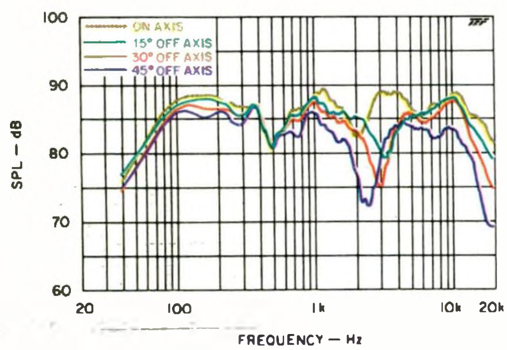

C

Fig. 5—Horizontal on- and off-axis frequency response for speaker upright (A), for speaker on its side and measured from woofer end (B), and for speaker on its side, measured from tweeter end (C).

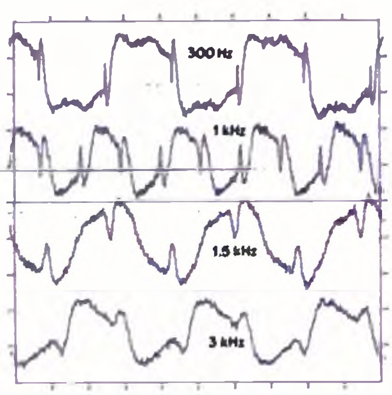

Fig. 6—Square-wave response.

Square-wave response indicates how well a speaker maintains the amplitude and phase relationships between a fundamental and its harmonics. A 300-Hz square wave reproduced by the RTL 1 (Fig. 6) exhibits a spike caused by the tweeter's output reaching the microphone 200 microseconds before the woofer's. The 1- and 1.5-kHz square waves also include output from both the woofer and tweeter, as these frequencies are still below the crossover; the tweeter's output is about 160 microseconds ahead of the woofer's at these frequencies. The 3-kHz square wave looks reasonably good because the tweeter and woofer outputs arrive at the microphone almost simultaneously. In the energy/time responses of the woofer and tweeter (Fig. 7), the tweeter's energy peak reaches the microphone about 100 microseconds before the woofer's initial peak.

Although there's an initial positive-going output in the RTL 1's response to a 20-kHz cosine pulse (Fig. 8), the large, negative-going output indicates that a listener might have difficulty determining the correct absolute polarity of some instruments, such as the trumpet. I myself had difficulty determining correct polarity.

When I measured the woofer's output and that of the reflex transmission-line opening with the microphone close to each, the woofer curve confirmed that the RTL 1 is tuned to 53.5 Hz. The output from the opening was greatest at about 100 Hz; a peak at 300 Hz, down only 3 dB, was probably due to the absence of acoustical damping material in the transmission-line tunnel. The maximum output for the woofer and opening together was at about 130 Hz.

I placed an accelerometer on the side of the RTL 1's enclosure to measure panel vibration. There was very little between 100 and 800 Hz, thanks to the bracing provided by the tunnel. I observed an increase in energy between 900 Hz and 1 kHz and a maximum peak at about 1.2 kHz.

On the rear panel, two pairs of five-way binding posts enable bi-wiring or biamping.

Use and Listening Tests

I asked a panel of listeners to compare the sound of the TDL RTL 1s to that of my reference speakers (which I designed). The RTL 1s were on 29-inch stands and placed so that the midpoint between each woofer and tweeter was 8 inches from the equivalent spots on the reference speakers. Because it was hard to determine the TDL speaker's absolute polarity, I simply hooked it up the same way as the reference, with the amp's red terminal connected to the speaker's red binding post and the black terminal to the black post.

THE RTL 1'S DISTORTION IS REMARKABLY LOW FOR A SPEAKER SYSTEM WITH A 6-INCH WOOFER.

The panel's comments on the TDLs' reproduction of the opening of Richard Strauss's *Ein Heldenleben*, performed by the Russian Symphony Orchestra under Mark Gorenstein (Pope Music PMG2012), were: "body of trombone less prominent," "strings brighter and more forward," "orchestra less full," "bass not as deep," and "thinner overall sound."

For the Allegro Assai from J. S. Bach's Brandenburg Concerto No. 2, performed by the Chamber Music Society of Lincoln Center conducted by David Shifrin (Delos DE 3185), comments were: "trumpets much brighter," "sharper flute," "not as full-sounding as reference," and "less body and warmth."

The instrumental "Lover Man," on Steve Davis's *Songs We Know* (dmp CD-3005), elicited the following comments: "very clear saxophone," "sax similar but slightly less body," "less deep bass," "guitar more forward," "guitar attack slightly muted," and "cymbals less distinct."

THE RTL 1s SOUNDED MORE LIKE MY EXPENSIVE REFERENCE SPEAKERS THAN EXPECTED.

"Grandmother," sung by Rebecca Pidgeon on the *Best of Chesky Classics & Jazz, Vol. 3* (Chesky JD111), caused the panel members to comment: "sharper voice," "voice more nasal," "voice thinner and more forward," "drum rim shots more forward," "rim shots brighter," "rim shots less precise," and "bass slightly boomier."

The listening panel considered the TDL speakers a good value, believing that they sounded more like the reference speakers, which would be much more expensive if they were commercially available, than the RTL 1's low price would suggest. (But because they do have a somewhat bright, forward sound, I suggest that you listen to these speakers for at least 15 or 20 minutes with familiar recordings before deciding whether to buy them.) And because of their conservative styling, the RTL 1s should fit into almost any room decor. I commend TDL for producing a speaker of the RTL 1's quality at such an affordable price. A

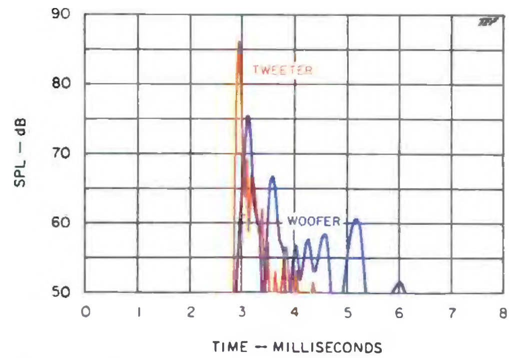

Fig. 7—Energy/time response.

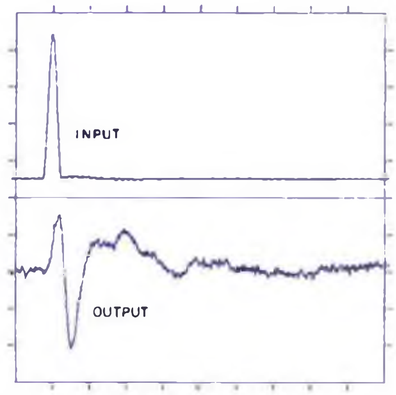

Fig. 8—Response to a 20-kHz cosine pulse.