EDWARD M. LONG

JOSEPH AUDIO RM7si SPEAKER

When Jeff Joseph, the owner of Joseph Audio, was working for Harvey's in New York City in the mid-1980s, the hi-fi store began selling a loudspeaker that used an unusual Infinite Slope crossover. The speaker was built by JS Engineering, and the crossover was invented and patented by Richard Modafferi and licensed to JSE. (Modafferi, who earned a reputation as the designer of the McIntosh MR78 tuner, is an independent consultant who operates Modafferi Acoustical Labs.) Joseph was impressed by the sound of the JSE speaker, as were the store's customers, who bought them in large quantities. JSE stopped producing the speaker, and eventually Joseph asked Modafferi about the possibility of licensing the patent. Modafferi agreed, so in 1991 Jeff Joseph established Joseph Audio to manufacture a loudspeaker with a crossover designed by Modafferi: the RM20, an 8-inch, two-way tower. (An intriguing footnote: When I called Joseph to get details about the RM7si and the background of his company, I asked if he was a relative of Bill Joseph. He told me that Bill was his uncle. Bill Joseph and Frank Robbins invented the RJ enclosure, which was quite a sensation when it was introduced in 1952 at the New York Audio Fair. It's gratifying that Jeff Joseph is carrying on the family tradition of producing unconventional loudspeakers.)

Photos: Michael Groen

Rated Frequency Response: 45 Hz to 20 kHz, ±2 dB.
Rated Sensitivity: 86 dB SPL at 1 meter for 1-watt input.
Recommended Amplifier Power: 30 to 150 watts per channel.
Dimensions: 9 in. W x 15 in. H x 11⅞ in. D (22.9 cm x 38.1 cm x 30.2 cm).
Weight: 25 lbs. (11.4 kg) each.
Price: $1,299 per pair in oak or black, $1,499 per pair in rosewood.
Company Address: 2 Pineridge Rd., White Plains, N.Y. 10603; 800/474-4434.
For literature, circle No. 91

The Joseph RM7si is a two-way speaker that uses a 6½-inch woofer with a glass-fiber cone and a 1-inch tweeter with a silk dome. A port on the front panel, 2 inches in diameter and 3 inches long, tunes the system. A removable, half-inch-thick grille with black cloth covers the front baffle. Behind the baffle, just above the woofer, is a ¾ x 1½-inch panel-stiffening brace and Owens-Corning R-19 acoustical material, which helps absorb sound from the back of the woofer. Delayed output might otherwise be reflected back through the cone and blur the sound.

On the back of the enclosure is a 4⅜ x 3⅝-inch input plate with two angled steps, each with a pair of custom, gold-plated, five-way binding posts that accept wire as thick as 12-gauge. Unlike many other binding posts, the RM7si's nicely accommodate the large spade lugs found on audiophile-grade cables. Additionally, these posts won't come loose or turn when they are tightened. To enable bi-wiring, the two pairs of binding posts are connected separately to the crossover's low- and high-pass filter sections. This lets you drive the bass and treble with separate speaker cables (or even separate power amplifiers). For normal operation, the two red and two black terminals are connected by removable gold-plated straps.

LISTENERS FOUND THE RM7si'S SOUND TO BE CLEAR, PRECISE, AND DETAILED.

The high- and low-pass filters are built on separate p.c. boards attached to the speaker's side panels. The high-frequency filter uses five inductors, 10 capacitors (ef-

fectively six, since some are paralleled), and five resistors; the low-frequency filter has three inductors, 10 capacitors (effectively four), and four resistors. I noticed that the high-quality polypropylene and polycarbonate crossover capacitors are hand-marked with their tested values. Each section's total capacitive value is precisely adjusted by combining separate capacitors. The inductors are also produced to very precise values. This precision isn't just icing on the cake; it's necessary because of the steep crossover slopes. Unless the high- and low-pass filters are exactly matched, there will be a dip in frequency response if the slopes are too far apart and a bump in response if they overlap.

The filters' circuitry is not like other crossovers'; the use of multiple inductors wound on the same laminated iron core exploits their mutual inductance to produce the steep filter slopes. Cardas cables are used for the internal wiring between the input and the crossover boards and from them to the woofer and tweeter.

The Joseph RM7si owner's manual explains how to connect the speakers, including bi-wiring them. It also discusses the drivers, the unique crossover, amplifier power requirements, and the effects of room placement on the RM7si's sound.

Measurements

Using a B & K 4133 microphone at a distance of 1 meter, I measured the Joseph RM7si under free-field conditions, away from reflecting surfaces, for all tests except the distortion measurements. (Free-field conditions allow the loudspeaker to radiate sound in all directions, as if it were in the center of an unrestricted sphere.) I measured distortion by placing the RM7si and the microphone on a concrete surface, which restricts the sound radiation to a half-sphere and increases the sound pressure level (SPL) by 6 dB. (This is sometimes called a ground-plane, or half-space, measurement, although a more technically correct description is "2-pi steradians conditions." The more technically correct terminology for free-field measurements is "4-pi steradians conditions.")

Figure 1 shows the frequency response of the bass and treble drivers with the grille in place and the speaker's overall response without the grille. (With the grille, the RM7si's overall response was virtually the same below 2.5 kHz and identical to the tweeter curve above that. Since the grille did affect the output, all other measurements and the listening-panel evaluations were made with it in place.) The woofer's output drops almost 30 dB in the octave between 1.5 and 3 kHz, and the tweeter exhibits a complementary rolloff between 2.5 and 1.5 kHz. While the crossover slopes aren't "infinite," they are much steeper than those found in conventional loudspeakers. The outputs of the woofer and the tweeter combine at the 1,937-Hz crossover frequency to produce response that is about 4.5 dB greater than either driver separately. If the outputs of the woofer and tweeter were perfectly synchronized, which they are not, the total output would be 6 dB greater than that of each driver separately.

The response measurements were made at 1 meter with an input of 2.83 volts rms, equivalent to 1 watt into 8 ohms. Joseph Audio specifies an output of 86 dB SPL for 1 watt at 1 meter, but the curves in Fig. 1 reveal that the output is less than that in the midrange.

Figure 2 shows the individual phase responses of the bass and treble drivers. Although not visible, their phases are 307.5° apart at the crossover frequency; the tweeter output is +22°, while the woofer output is –285.5°. If the outputs of the two drivers were 360° apart at the crossover, they would also combine to give 6 dB more output than each individually, but only with steady-state signals; transient outputs still would not be synchronized. The 30-second sweep signal I used is slow enough to appear almost steady-state as it moves across the crossover frequency. (I chose a 30-second sweep to obtain more detailed information about the output of the RM7si in the frequency domain, especially at low frequencies. If you want high resolution in the frequency domain,

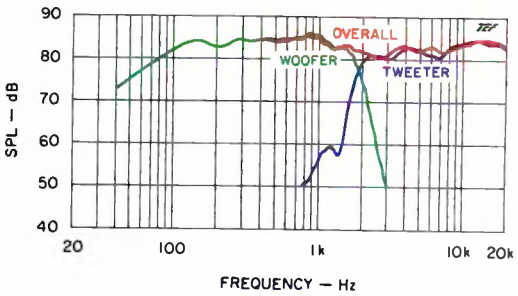

Fig. 1—Frequency response (drivers' responses made with grille, overall response made without it).

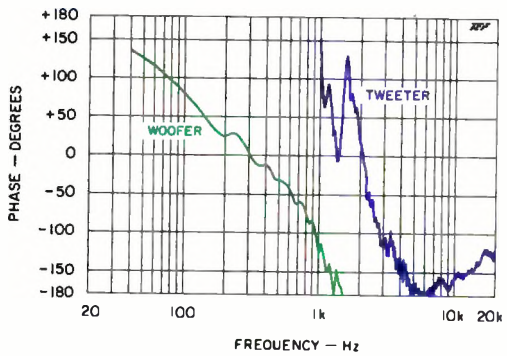

Fig. 2—Phase response.

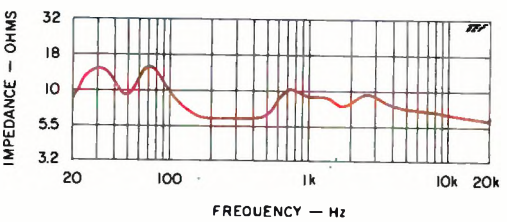

Fig. 3—Impedance magnitude.

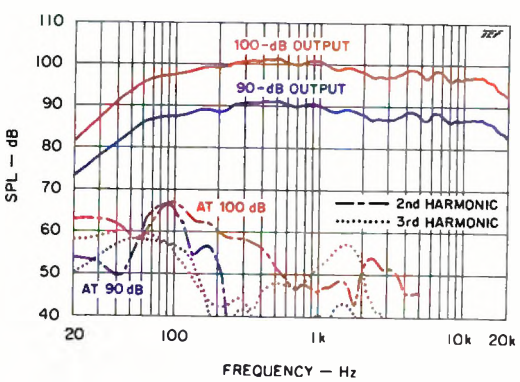

Fig. 4—Ground-plane frequency response and second- and third-harmonic distortion.

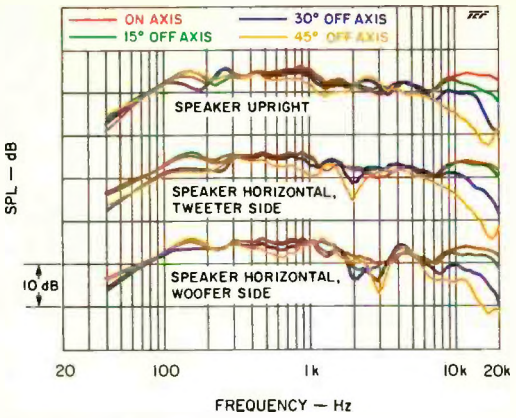

Fig. 5—On-axis and horizontal off-axis responses.

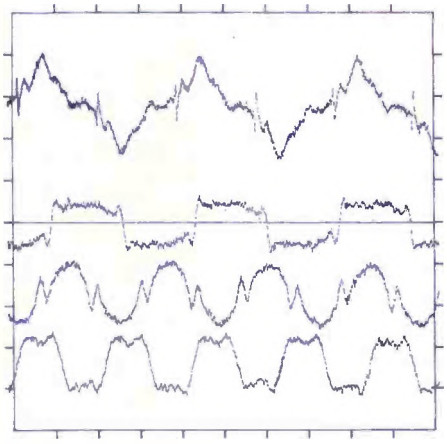

Fig. 6—Square-wave response at (from top) 300 Hz, 1.2 kHz, 1.6 kHz, and 5 kHz.

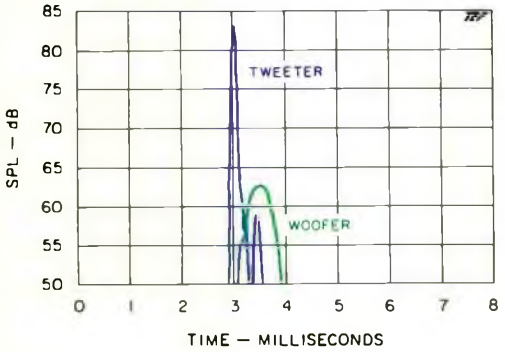

Fig. 7—Energy-time responses; woofer response has been raised 10 dB for clarity.

you have to give up resolution in the time domain, and vice versa.)

Figure 3 shows how the RM7si's impedance varies with frequency. The two peaks in the bass reveal that the RM7si is a classically tuned, ported system; the dip between them indicates that the speaker is tuned to 49 Hz. The maximum impedance, 14.5 ohms, occurs at 73.1 Hz; the minimum impedance, 6 ohms, is at 300 Hz. The RM7si should be a very easy load for any amplifier.

Distortion at output levels of 90 and 100 dB SPL is shown in Fig. 4. At the 100-dB level, the second-harmonic distortion at 100 Hz is only 3%, and the third-harmonic distortion is 1.6%. This is very good performance, considering the size of the woofer.

The on-axis and horizontal off-axis frequency responses of the Joseph RM7si, with the speaker upright and on its side, are in Fig. 5. The off-axis response is excellent with the speaker upright (top), especially at a 30° angle. Although I concur with Joseph Audio's recommendation that the RM7si's be placed on 24-inch-high stands, with the tweeter above the woofer, the middle and bottom sets of curves show that if you must place them horizontally on shelves, they should be oriented with their tweeters toward the inside. The dip near 2 kHz in the middle set of curves is at a fairly extreme angle of 45° off the center axis; at lesser angles, it all but disappears.

Because music and speech are complex transient signals, I consider transient test signals to be as important as, if not more important than, steady-state test signals (unless you like to listen to recordings of someone whistling or playing an ocarina). A square wave is not, strictly speaking, a transient signal, but it does consist of a fundamental and a number of harmonics that have specific amplitude and phase relationships. If a speaker system is fed a square wave, with the fundamental and the first few harmonics reproduced by the woofer and the upper harmonics reproduced by the tweeter, the arrival of the sound from the two drivers must be synchronized, or phase integrity will be lost. This will result in poor square-wave reproduction, which implies that complex music and voice reproduction will be less than ideal.

Fig. 6 shows square waves reproduced by the Joseph RM7si. The downward slope of the 300-Hz square wave (top) indicates that some low-frequency phase shift is occurring below this frequency, which is not unusual, and that the high-frequency harmonics are arriving before the fundamental. The 1.2-kHz square wave (middle of graph) is very good, but in this case only the fundamental is reproduced by the woofer while the harmonics are reproduced by the tweeter. The 1.6-kHz square wave (second from bottom), just below the crossover frequency, reveals that the fundamental and the harmonics are not synchronized. In the bottom trace, of a 5-kHz square wave, the tweeter is reproducing both the fundamental and the harmonics of the square wave; the result is better than from most other tweeters I have tested.

THE BASS FROM THE RM7si WAS VERY GOOD FOR A SYSTEM OF ITS SIZE.

Figure 7 shows the energy/time curves of the two drivers. The difference between t tweeter signal's arrival and the woofer's about 460 microseconds, which corr sponds to an offset of about 6¼ inches. I i creased the signal input to the woofer by dB to make its curve easier to see. (The te signal is weighted to produce more outpu as frequency is increased, naturally favorin the tweeter.)

The cosine-pulse test (Fig. 8) confirms that the Joseph Audio RM7si produces a very tight energy package, with no high-frequency ringing, and that the system is well damped. (The time span for this graph is 511 milliseconds.)

I also measured the near-field output of the woofer and the port as well as the combined output of both. There was a dip in the woofer's output at 41.1 Hz, where the port tunes the system. The port output was strongest slightly above the tuning frequency. The combined output of the woofer and

the port was very uniform down to 60 Hz and was down only 3 dB at 53 Hz.

My accelerometer measurements of cabinet panel vibration showed very little output except for a plateau of energy from 400 to 500 Hz. This tapered off gradually to a minimum at 700 Hz and higher frequencies. The outputs of the two RM7si speakers matched within 0.5 dB across the audible spectrum, which may account for the excellent images they produce, especially the solid center image.

Use and Listening Tests

I asked members of my listening panel to note comments as they compared the sound of a compact reference speaker (which has a uniform bass output and is down only 3 dB at 32 Hz) to that of the Joseph RM7si. Most listening was done individually, but each panel member heard the same music and vocal selections. As recommended by Joseph Audio, these speakers were placed on 24-inch-high stands (roughly the same height as the reference speakers) and positioned away from reflecting surfaces.

Although I didn't ask the members of the panel to listen for effects of absolute polarity, I did check it myself. On some music and voice program material, I found it difficult to determine; on other recordings, I thought reversed polarity sounded slightly more real. Perhaps the relatively large negative-going pulse evident in the cosine-pulse test (Fig. 8) might explain this (for the listening tests, the RM7si was connected with the polarity used for that measurement). It also may account for some of the comments made by the listening panel that certain transients sounded slightly duller on the RM7si than on the reference speaker. If you are a critical listener, try reversing the polarity of the connections to the RM7si while listening to program material with sharp transients: You may hear a difference.

Listening to the RM7si speakers on the selection "Birdland," played by pianist Earl Hines on the CD *Fatha: Earl Plays Hits He Missed* (coupled with *For Duke by Bill Berry and His Ellington Orchestra* and packaged as Realtime RT-5001), panel members noted: "piano clear and precise," "piano more centered," "brushes on drums more muted," "rim hits on drum slightly duller," "bass is good but less deep," and "tuba breath sounds more prominent." For the selection "Bantu," by Andrew York, performed by the Los Angeles Guitar Quartet on the CD *Surround Spectacular* (Delos DE 3179), comments about the RM7si were: "imaging is good but less spacious," "guitars sound more mellow," "guitars more centered," "drums less reverberant," and "drums very tight." Palestrina's "Alma Redemptorsi," sung by the Voices of Ascension and conducted by Dennis Keene on the same CD, prompted the panel to comment: "very detailed but slightly less spacious," "better imaging," "individual voices more distinct," and "the group sounds less wide and more forward."

When panel members heard the RM7si's reproduce Kodaly's "Viennese Musical Clock" on the *Audio Plus Sampler CD* (Audio+ CDX007), they noted: "chimes more recessed," "chimes brighter, with more ringing," "trumpet slightly constricted," "brass slightly muted," "flutes are light and airy," "instruments seem more distinct," and "high sounds are smoother and more extended."

There seemed to be a consensus from the panel that the RM7si's bass was very good for a system of its size but less deep than the reference speaker's, which was hardly surprising because the reference is down only 3 dB at 32 Hz. The lack of deep bass was most noticeable on movie soundtracks having low-frequency effects. Use of a subwoofer with the RM7si is recommended when listening to such movies.

After the listening panel completed its evaluations, I received review samples of the new Signature version of the RM7si, which costs about $400 more per pair. Its sound was quite similar to that of the standard RM7si but had more clarity in the voice and treble range. The RM7si Signature made dialog on movie soundtracks much more articulate and easier to distinguish, especially when other sound effects were occurring simultaneously. The Signature's reproduction was definitely brighter and less recessed.

The RM7si is a very good loudspeaker that incorporates some notable technology. The infinite-slope crossover's low-pass filter does indeed provide a very steep rolloff, albeit with the attendant low-frequency delay associated with such a steep slope. All low-pass filters introduce delay, so the trade-off between greater delay and greater attenuation of energy fed to the RM7si woofer may be acceptable.

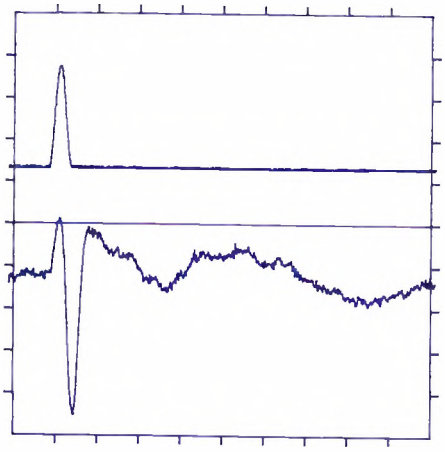

Fig. 8—Response to a 20-kHz cosine pulse; input (top) and output (bottom).

The RM7si's binding posts can hold large spade lugs or 12-gauge wire and stay tight.

I found the Joseph Audio RM7si to be very pleasant and enjoyable for long-term listening. The sound was very precise; in fact, it reminded me of the clarity that I've heard in a dry, reflection-free environment. The RM7si definitely sounds different from most other moderate-sized loudspeakers, and I recommend that you visit an audio dealer and listen to it. Take along music with which you are familiar, including voice recordings, and remember my suggestion about switching the polarity on program material having sharp transients. And don't be in too big a hurry; you may discover you'll like this speaker a lot. A