D. B. KEELE, JR.

# JBL SVA1600 SPEAKER

The SVA1600 has a lot in common with JBL's recent studio monitors, which combine direct-radiator woofers with Bi-Radial constant-coverage horn tweeters. The major difference between the SVA1600's horn and the horns in JBL's pro models is its use of a dome driver rather than the more expensive compression drivers, which are better suited for professional use.

The SVA1600 has two 6½-inch woofers and is the second smallest of the five main-channel speakers in JBL's SVA series. The others, whose woofers range from 5¼ to 10 inches, are priced at $899 to $2,000 per pair. All the SVA systems have vented enclosures, magnetically shielded drivers, and black, wood-grain vinyl finishes. There's also an SVA Center, at $549; it's essentially identical to the SVA1500, but with its horn rotated 90° for horizontal operation.

Each of the SVA models has a Bi-Radial horn with soft-dome driver, placed between a pair of woofers that operate in parallel over the whole low-frequency range. In the SVA Center, the woofers flank the tweeter horn. In the other models, the woofers are above and below the horn; that's the so-called D'Appolito arrangement, which JBL calls a Symmetrical Vertical Array (hence SVA for the line's name). The company says this configuration produces "a virtual full-range source that appears to radiate from a single location, or point source, on the loudspeaker."

Using the Bi-Radial tweeter in these home speakers lends them the cachet of JBL's professional monitors. But a better reason to use them is that, as in recording studios, the constant-coverage horn helps control the speaker's directivity and thus its imaging characteristics. The Bi-Radial horn has wide but controlled horizontal coverage and a narrower vertical coverage, rated by JBL as 90° and 40°, respectively, to minimize sound bouncing off the side walls and ceiling. This gives the listener more direct and less reflected sound, just what's required for accurate imaging of music and for intelligible reproduction of dialog in movies. JBL also states that the SVA speak-

**JBL'S SVA1600s OFFER DISTINCTIVE LOOKS AND SOUND AT A VERY COMPETITIVE PRICE.**

**Rated Frequency Response:** 50 Hz to 18 kHz, ±2 dB; –6 dB at 38 Hz and 20 kHz.
**Rated Sensitivity:** 89 dB at 1 meter, 2.83 V rms applied.
**Rated Impedance:** 8 ohms.
**Recommended Maximum Amplifier Power:** 200 watts.
**Dimensions:** 35¾ in. H x 11 in. W x 13½ in. D (90.8 cm x 27.9 cm x 34.3 cm).
**Weight:** 60 lbs. (27.3 kg) each.
**Price:** $649 each.
**Company Address:** 80 Crossways Park West, Woodbury, N.Y. 11797; 800/366-4525.
For literature, circle No. 91

*Photos: Michael Groen*

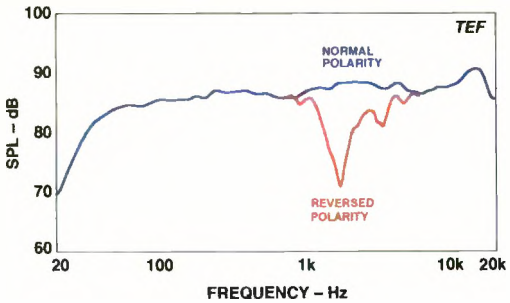



Fig. 1—Frequency response.

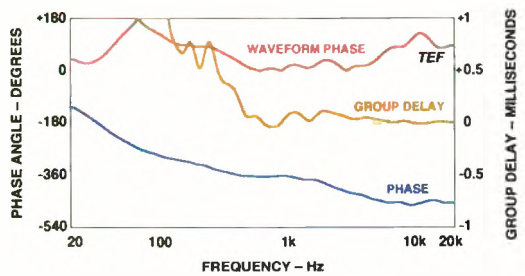



Fig. 2—Phase response, group delay, and waveform phase.

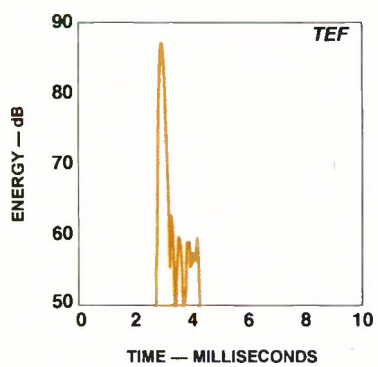



Fig. 3—Energy/time response.

ers' high and uniform directivity, coupled with frequency response that stays relatively constant off axis, enables them to provide good sound regardless of room acoustics and listener position.

(The Bi-Radial constant-coverage horn holds special interest for me, because I hold the patents on it as well as on Electro-Voice's constant-directivity horn design. I developed them when working for those companies in the '70s and early '80s. However, having signed away my rights to these patents when I left each company, I have no financial stake in them.)

The SVA1600's 6½-inch woofers have frames made from cast aluminum for strength and rigidity, and their magnet structures have been optimized to decrease distortion. The woofers' four-layer copper voice coils are wound on high-temperature fiberglass formers. The cones are felted fiber attached to rubber surrounds.

The SVA1600's 1-inch soft-dome tweeter, made by JBL's sister company, Audax, is cooled with Ferrofluid. The horn is designed to operate with this tweeter and is made of ABS structural foam, which damps resonances. According to curves sent to me by Greg Timbers, the SVA systems' designer, the dome driver by itself is quite flat from 2 to 16 kHz. The horn not only restricts the tweeter's directional coverage but greatly increases its sensitivity between 1 and 4 kHz. Because of the increased sensitivity, the tweeter's drive level in this band must be reduced to match the sensitivity of the woofers. This, in turn, greatly reduces distortion.

The SVA1600's cabinet is solidly built of ¾-inch medium-density fiberboard. Molded-plastic grilles for each woofer attach with pegs to the front of the cabinet; the horn is not covered. Adjustable spiked feet beneath the cabinet's front let you tilt the speaker back to direct the horn (which is only 24 inches above the floor) toward the listeners' ears. Under the rear panel are two other feet, 1 inch in diameter and 1 inch high.

The SVA1600's crossover is mounted on a small board inside the cabinet, just above the input connection panel on the back. Some of the crossover's 16 components are paralleled, so there are effectively only 11 circuit elements. The crossover consists of a second-order (12-dB/octave) high-pass filter and a second-order low-pass. The feed to the tweeter includes a series resistor bypassed by a capacitor, a simple equalization circuit to flatten the response of the dome-driven horn. The tweeter level can be adjusted by switching in a resistor to ground; the switch is centered among the input terminals. The SVA1600 is said to have flat response when this switch is in its "0 dB" position and to have a smoothly rising high-frequency response in the "2 dB" position. Audiophile-quality parts are used throughout the crossover network, including small polypropylene capacitors in parallel with the filter capacitors.

The gold-plated input terminals, of JBL's own design, are very widely spaced for easy connection; the high- and low-frequency input-terminal pairs are 3¼ inches apart, and the positive and negative terminals for each pair are on 1¾-inch centers. Two robust, gold-plated straps connect the high- and low-frequency terminals but can be removed for bi-wiring.

## Measurements

I measured the SVA1600's frequency response (Fig. 1) on the tweeter's axis, the height JBL recommends. I made the tests in a large anechoic chamber and also outdoors, using ground-plane techniques. If you exclude the peak at 15 kHz, the curve made with normal tweeter polarity fits within a tight, 3-dB, window from 100 Hz to 20 kHz. Even with the peak, the curve fits within a 6-dB window from 50 Hz to 20 kHz, still good performance. Compared to the level at 100 Hz, the SVA1600 is 3 dB down at 41 Hz and only 6.7 dB down at the low frequency of 30 Hz. A shallow hump, two octaves wide, is centered at 1.75 kHz, the crossover frequency.

When I reversed the tweeter's polarity by reversing the connections at its terminals, a large dip developed at the crossover point and the level from 1 to 4 kHz was reduced. This indicates that when the tweeter is connected for normal polarity, the horn and woofers are essentially in phase through the crossover region. That's very desirable, as it minimizes lobing (which the D'Appolito configuration's vertical symmetry should virtually eliminate anyway) and puts the SVA1600's maximum radiation on axis.

**THE SVA1600'S CONTROLLED COVERAGE STEMS FROM ITS HORN AND THE ARRANGEMENT OF ITS DRIVERS.**

Averaged from 250 Hz to 4 kHz, sensitivity was 87.1 dB, about 2 dB below JBL's rating. The right and left speakers matched

closely, within ±0.5 dB, between 20 Hz and 10 kHz. Above 10 kHz, one speaker's sensitivity slightly exceeded the other's, with the greatest difference, 1.1 dB, occurring at 16 kHz. The woofer grilles caused no significant change in response.

Figure 2 shows the SVA1600's phase and group-delay responses, referenced to the tweeter's arrival time. The phase curve falls with frequency before leveling off to about –450° above 8 kHz, in the horn's range. Above 500 Hz, the group-delay curve indicates that the woofers lag the tweeter by only 25 to 50 microseconds, a sign that the tweeter horn and woofers are very close to being aligned in time and position. The close alignment between this speaker's drivers is also reflected in the waveform phase. This curve (actually the absolute value of the wrapped waveform phase) indicates how well a speaker will preserve waveforms. Because failure to preserve them well (which is the norm) doesn't seem to affect sound quality significantly, I don't regularly present this curve. However, the SVA1600's waveform phase stays between 0° and 40° from 400 Hz to 5 kHz, which means that this speaker *will* preserve waveforms whose energy is concentrated within that frequency range.

**THE JBLs' SOUNDSTAGE WAS EXCEPTIONALLY CLEAR, DELINEATING EACH INSTRUMENT VERY WELL.**

Figure 3 shows the JBL SVA1600's energy/time response. The main arrival, at 3 milliseconds, is very compact and sharp; later responses are quite low in level and mostly more than 28 dB below the main arrival's level. This is one of the best energy/time response curves I have obtained and is another indication of close time coherence between the tweeter horn and the woofers. (I have not been including energy/ time measurements in my equipment reviews lately, as most of them have been quite similar and not very revealing. My new policy is to present the results of this test only if they are significantly better or worse than normal.)

As you can seen in Fig. 4, horizontal off-axis response is extremely uniform up to 12.5 kHz. It narrows slightly above that but is still very uniform out to ±20° off axis. The vertical off-axis responses (Fig. 5) are quite symmetrical above and below axis; however, except for the two ridges above and below the axis at about 800 Hz and 1.7 kHz, you can't clearly see this in the figure. In the main vertical listening window, ±15°, the curves are quite uniform except near the crossover. Even in the crossover range, from 1 to 4 kHz, the responses are quite flat within 5° of the axis; farther off axis are obvious depressions, where the vertical coverage narrows significantly. This narrowing is caused by the SVA1600's woofers being 17 inches apart (from center to center), corresponding to 2.2 wavelengths at 1.75 kHz, the crossover frequency.

The JBL's impedance magnitude (Fig. 6A) has the two bass peaks that characterize vented enclosures; the 36-Hz dip between them indicates the enclosure's approximate tuning frequency. The maximum impedance is 41.5 ohms and the minimum is 5.7 ohms, yielding a high overall variation of 7.3 to 1 (41.5 divided by 5.7) within the audio band. Because the minimum impedance is not very low, you can use cables having relatively high resistance: Cable series resistance can be as high as 0.077 ohm before cable-drop effects will cause response peaks and dips greater than 0.1 dB. For a typical run of about 10 feet, that would correspond to 16 gauge (or larger), low-inductance cable.

The SVA1600's impedance phase (Fig. 6B) reaches a maximum angle of +47.5° and a minimum of –47°, so a single SVA1600 should not be a difficult load for most amplifiers.

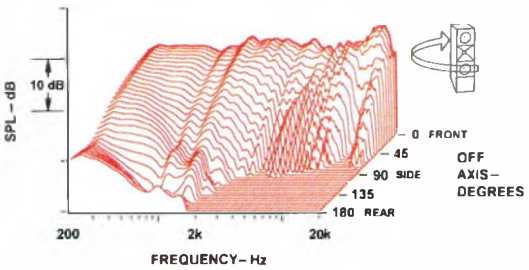



Fig. 4—Horizontal off-axis frequency responses.

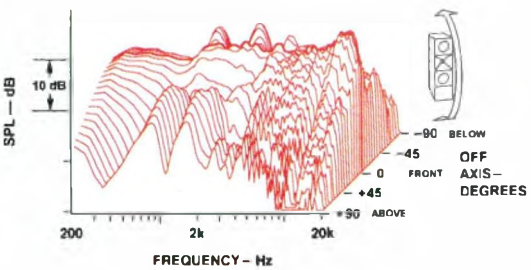
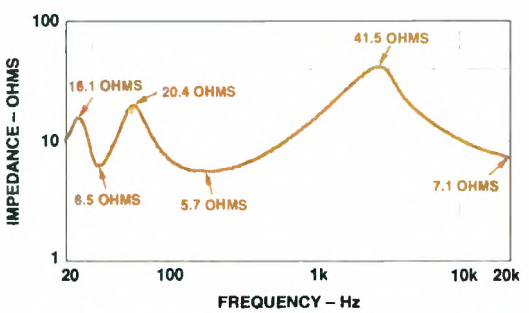



Fig. 5—Vertical off-axis frequency responses.




A

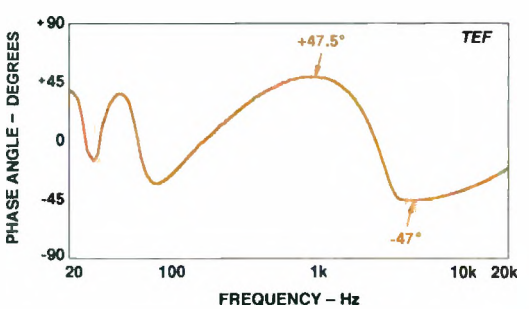



Fig. 6—Impedance magnitude (A) and phase (B).

B

The SVA1600's cabinet is quite solid. Generally, it was quite free of vibration; a high-level sine-wave sweep revealed only one noticeable cabinet vibration, at about 235 Hz. The woofers overloaded quite gracefully when overdriven and exhibited a maximum excursion of about 0.5 inch, peak to peak. At the 36-Hz box resonance, the vent reduced the woofers' excursion only moderately, by about 40%, which I found by closing the port for a comparison measurement. I did not detect any dynamic offset.

Lobing is minimized by the design and placement of the JBL SVA1600's horn.

To test the SVA1600's 3-meter room response (Fig. 7), I raised the front of the cabinet by adjusting the spikes so that the tweeter horn was aimed at my measurement microphone. Except for a slight dip at 510 Hz and the high-frequency peak at about 15 kHz (which is also seen in Fig. 1), the averaged curve is very flat and smooth, fitting a tight, 5.5-dB, window.

Figure 8 shows the SVA1600's $E_1$ (41.2-Hz) harmonic distortion for power levels up to 50 watts. The second harmonic rises to a moderate 9.3% and the third to a slightly lower 8.6%; higher harmonics are less than 2%. The speaker sounded quite clean at all the power levels in this test, and port wind noise was moderately low.

The SVA1600's intermodulation distortion rises gradually, reaching the fairly low level of 4.8% at 50 watts (Fig. 9). This is quite good for a system whose woofers are reproducing both test tones, 440 Hz ($A_4$) and 41.2 Hz ($E_1$).

Short-term peak power input and output are shown in Fig. 10. Peak input power starts at a moderately low 18 watts at 20 Hz, rises to a plateau of about 170 watts between 40 and 50 Hz, rises again to about 3 kilowatts between 250 and 500 Hz, and winds up at a high 5 kilowatts or so above 1 kHz. With room gain, peak acoustic output starts at a high 91 dB SPL at 20 Hz and rises very rapidly, passing through 100 dB at 26 Hz, 110 dB at 39 Hz, and 120 dB at 140 Hz; output is a bit greater still at higher frequencies. The SVA1600's bass output is well above the average of speakers I've tested. That's worthy performance, considering the size of the woofers and the cabinet.

### Use and Listening Tests

I found the JBL SVA1600s to be of reasonable weight for their size. They were fairly easy to lift and move, using the port and the top as handholds. The adjustable spiked feet made it easy to set up and aim the speakers. These spikes are part of a metal bracket assembly that extends across the bottom front of the cabinet. By turning a knurled knob, you can retract the spikes to move the SVA1600 around or extend them, by about ¾ of an inch, to lock the speaker into position and to tilt it back.

JBL has a reputation for not stinting on visual design or on fit and finish. The SVA1600's solid and well-constructed cabinet shows this attention to appearance, exemplified in such details as the horn and its flange, the input terminals, the woofer grilles, and the adjustable spikes and their frame assembly.

The eight-page owner's manual covers placement, hookup (including wire size and bi-wiring), angle adjustment, tweeter-level adjustment, and troubleshooting. In the section on angle adjustment, a diagram shows how to adjust the spikes but there's no explanation about how high these speakers should be aimed or whether they should be canted in. My listening tests revealed that the horn must be aimed at your ears for proper sound, so I canted the speakers in and tilted them accordingly.

I listened to the SVA1600s with their woofer grilles in place and with the tweeter-level switch at its "0 dB" (unboosted) position. I used single-wire connections. The other components in my system included an Onkyo Integra DX-7711 CD player, a Krell KRC preamp, a Crown Macro Reference power amp, and Straight Wire cables and interconnects. I used B&W 801 Matrix Series 3 speakers for comparisons. The JBLs and B&Ws matched quite closely in sensitivity.

The first disc I listened to during these sessions was *No Borders* (GRP Records

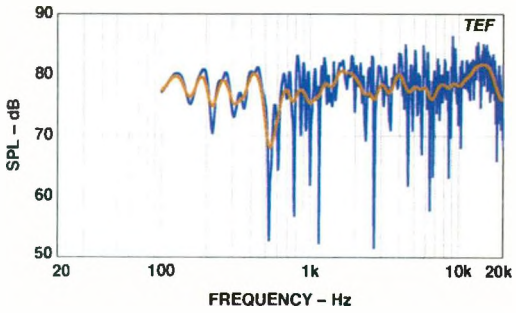



Fig. 7—Three-meter room response.

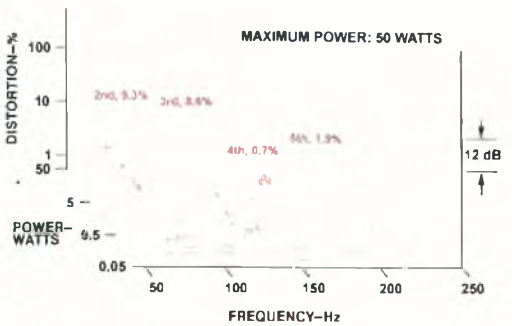



Fig. 8—Harmonic distortion for $E_1$ (41.2 Hz).

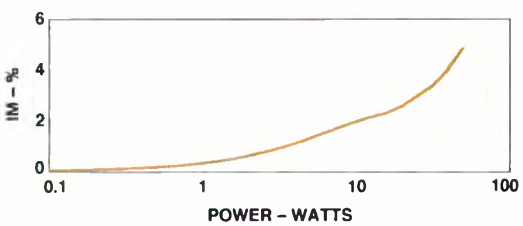



Fig. 9—IM distortion for $A_4$ (440 Hz) and $E_1$ (41.2 Hz).

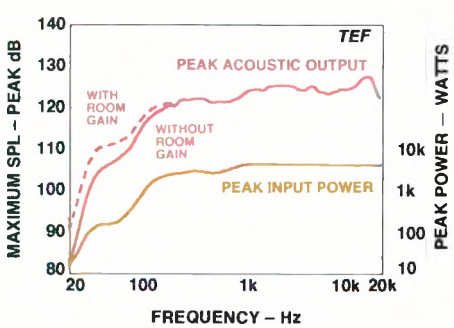



Fig. 10—Maximum peak input power and sound output.

GRD-9676), a most interesting and well-recorded jazz album by Don Grusin. The JBL speakers performed quite ably, presenting an exceptionally clear soundstage and delineating individual instruments very well. The JBLs' sound was significantly closer, more up-front, and less diffuse than the comparatively laid-back, staid sound of the B&Ws. I was strongly impressed by the SVA1600's tight and extended bass and its spectral balance and timbral accuracy. Dynamic range was likewise impressive, and percussion and rim shots were particularly realistic.

On third-octave band-limited pink noise, the SVA1600s' output was strong and clean from the 32-Hz band on up. There was no usable output at 20 Hz but some in the 25-Hz band. I heard a bit of wind noise from the speakers' ports in the 32- and 40-Hz bands. And the JBLs sounded somewhat strained on noise peaks when I raised the 50-Hz band's input level until the woofers reached their excursion limits. When I listened sitting down, the SVA1600s exhibited only minimal tonality on pink noise, but with a slight high-frequency lift and a more forward, less reverberant sound than the 801s. When I stood up, however, the JBLs presented a much less up-front sound, closer to the B&Ws' presentation yet with significant midrange differences and some treble loss.

On cleanly recorded vocals, the SVA-1600s did emphasize sibilants a bit but did not have the harshness that some speaker systems impart. The SVA1600s' up-front character worked quite well on most vocals. On cathedral-recorded choral music, their close-up sound was less appropriate and I preferred the more diffuse sound of the 801s even though the lyrics were more intelligible on the SVA1600s. In any case, if you don't like the JBLs' front-and-center character, you can modify it by reducing the speakers' upward tilt (or by standing up, for that matter).

On big-band jazz, the SVA1600s' up-front character did very well by the bands' horn sections. Front-and-center horn solos were particularly well and realistically reproduced. The speakers' side-to-side coverage was excellent.

The SVA1600s' imaging was second to none. On intimately recorded chamber music, placement of the instruments' images

Wide spacing between pairs of terminals allows easy access for making and tightening connections.

was spot on, and center images were noticeably cleaner and better delineated than with the B&Ws. On most recordings having centered soloists, the center images were quite palpably realistic. That's probably because the high directivity of the SVA1600s' horns increased the proportion of direct to reflected sound I heard, a characteristic that would also be advantageous if you used these speakers in the main channels of a home theater.

The SVA1600s could play loudly and cleanly. Rock, country, and complex symphonic music sounded equally natural when played loud. Kick drums were solid and tight, though they had a bit less punch than they did over the 801s at the same level. Although the JBLs' output in the very low bass didn't match the B&Ws', the JBLs reproduced most pipe organ music with appropriate authority. Pedal notes were good and solid, and I noticed no intermodulation of upper frequencies.

The JBL SVA1600s were very good all-around performers. They offer quite distinctive looks, features, and sound at a very competitive price. Their horn-loaded tweeter gave the sound a distinctively up-front character but without any of the anomalies often associated with horn loading. And the SVA1600s' controlled directionality should help them deliver excellent sound and accurate imaging, even in rooms whose acoustics are less than ideal. A