

Rectilinear[®]

A MEDIUM-PRICED BOOKSHELF
SPEAKER SYSTEM
OF OPTIMUM QUALITY

Basic Configuration

The Rectilinear XII is a three-way speaker system utilizing a woofer, a midrange driver and a tweeter, all of the moving-coil principle but of somewhat unconventional design. The cabinet has the typical dimensions of full-size bookshelf speakers but is unconventional in that it is a tube-vented bass reflex enclosure instead of being completely enclosed.

Design Goals

The Rectilinear XII was designed to make available in the medium-price category a book-

Classic Series BOOKSHELF SPEAKER

shelf speaker closely approaching the state of the art in audible and measurable performance. The utmost accuracy of response and the lowest possible distortion were sought, without regard for conventionally accepted standards in medium-priced speaker systems. Particular emphasis was placed on low *time delay distortion*. High efficiency without loss of bass response was another major objective, since the speaker would most probably be used with medium-priced receivers and amplifiers of

XII

somewhat limited power output. This consideration also demanded a relatively constant impedance across the frequency spectrum.



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Woofers

A highly sophisticated woofer is one of the main reasons for the unusual performance of the Rectilinear XII. Its diameter is 10 inches, which is considered by Rectilinear engineers to be optimum size for virtually any bookshelf speaker. It has faster transient response than 12-inch or 15-inch units and, despite its smaller cone, can move sufficient air to produce undistorted bass fundamentals at very high volume levels when used in the proper enclosure. This is possible because the special butylized cloth surround, in combination with the spider and voice coil construction used, permits wide excursions with complete linearity.

Above 350 Hz, the response of the woofer is rolled off at the rate of 12 dB per octave, so that its operating range does not extend beyond the lowest midrange frequencies. Not allowing the woofer to contribute significantly to the overall midrange response is an important design characteristic of the Rectilinear XII, being largely responsible for its low time delay distortion and lack of midrange coloration. However, to assure a smooth upper bass, provision must be made for unimpaired woofer response well up into the midrange. This is difficult to accomplish with a small-diameter voice coil driving a large diaphragm; therefore a large voice coil of 2-inch diameter is used.

Since high efficiency is essential to the design concept of the Rectilinear XII, the woofer requires an unusually efficient magnet structure. The 1-lb. Alnico V slug used is probably the largest to be found on any 10-inch speaker. (Not to be confused with heavier but less powerful ceramic magnets.) An extra-long magnetic path is provided so that maximum electrical damping is applied to the moving mechanism. This results in unusually low distortion at high output levels, which is not an easy feat in a bass reflex design.

Rectilinear[®] XII

Midrange Driver

This is a 5-inch unit with a 2-inch "whizzer" cone. The entire dual cone structure moves as a rigid piston at the lower midfrequencies; at the higher frequencies a gradual decoupling takes place and only the whizzer cone moves. Thanks to a unique European paper used in fabricating the cone structure, plus an unusually light self-supporting voice coil, transient response is exceptional throughout the driver's operating range and beyond.

Below 350 Hz and above 4000 Hz, the crossover network of the Rectilinear XII rolls off the response of the midrange driver at the rate of 6dB per octave. This leaves almost four important octaves to be covered by this unit, in the range containing most of the specific frequency characteristics that differentiate the various musical instruments and voices. Thus the exceptionally smooth and neutral character of the speaker system's response owes a great deal to its midrange design.

Voice coil diameter of the midrange driver is 1 in.; total magnet weight is ¾ lb.

Tweeter

This is a 2½-inch unit that covers the range from 4000 Hz up. The tweeter is of classically simple design, with extremely light cone and voice coil structure, and surpasses in smoothness, transient response and dispersion characteristics all other moving-coil tweeters thus far tested by Rectilinear engineers. To assure excellent power handling at the bottom of the tweeter's range, a relatively large voice coil with a ½-inch diameter drives the diaphragm. Low moving mass is assured, however, by the construction of the cone and by the characteristics of the surround material.

Crossover Network

The Rectilinear XII abandons the conventional parallel-type crossover network in favor of an unorthodox series configuration. The three

drivers are connected in series, with properly calculated reactances shunting each. Thus the inductive elements become the high-pass filters and the capacitances the low-pass filters. This perfectly straightforward but non-conformist solution results not only in vastly improved phase response but also in somewhat higher efficiency.

The various coils and capacitors are calculated to produce crossover points at 350 Hz and 400 Hz; precisely controlled tolerances assure a high degree of accuracy and repeatability. The midrange driver and the tweeter are each provided with a wide-range level control, accessible on a recessed panel in back of the speaker, so that a judicious amount of deviation from flat response may be applied to suit the acoustic environment.

Cabinet

The outside dimensions of the Rectilinear XII are 25" x 14" x 10¾" deep. The cabinet is of extremely rigid one-piece construction, in ¾-inch stock, with heavily damped walls. It is filled with sound-absorbent material and the drivers are mounted from the front. The cabinet edge is only 3/8-inch deep to eliminate diffraction effects. The finish is oiled walnut.

The enclosure is tuned for optimum bass response by means of tube venting, in a sophisticated application of the bass reflex principle. Bass reflex cabinets are seldom used in bookshelf speaker systems, but in the case of an unusually efficient speaker like the Rectilinear XII, this is the best technique for maintaining efficiency down into the low bass without roll-off. (In a completely enclosed cabinet, response would drop 6 dB from 100 Hz to the fundamental resonance of 50 Hz. Or, alternately, midbass efficiency would have to be sacrificed.)

Impedance and Efficiency

The nominal impedance of the Rectilinear XII is 8 ohms. The impedance never drops below 7.5 ohms, assuring that the speaker cannot overload solid-state amplifiers of limited power capability. Maximum impedance is at 51 Hz, where the woofer and tube-vented cabinet show a single impedance peak of 25 ohms. This relatively low figure is an indication of the excellent damping (low Q) of the bass reflex design used.

Efficiency is close to the ultimate achievable in a bookshelf system of limited cost. Any amplifier capable of 10 clean watts per channel will drive the speaker to window-rattling levels.

Frequency Response

Although Rectilinear engineers strongly believe that there are more important speaker specifications than pressure amplitude response (the conventionally cited "frequency response"), the curve of the Rectilinear XII happens to be essentially flat from 45 to 17,000 Hz.

Dispersion

The superior design of the tweeter and the shallow edge of the enclosure assure an excellent radiation pattern right up to the highest frequencies. Dispersion is wide enough to make high-frequency transients fully audible off axis, without loss of quality.

Time Delay Distortion

It is becoming increasingly apparent that phase response (phase angle plotted against frequency) is a more significant criterion of speaker performance than what is ordinarily called frequency response (pressure amplitude plotted against frequency). Between two reasonably advanced speaker systems, the one with the better amplitude response is not necessarily the one that sounds better (i.e., more natural or lifelike). But the one with the better phase response will be almost invariably

preferred by the critical listener.

Superior phase response is dependent on low time delay distortion. Time delay distortion occurs when a speaker does not produce an acoustical output the instant an electrical input is applied to it. There is a measurable split second of delay between input and output. The delay is nearly always frequency-dependent, being greater at low frequencies as a result of the higher inertial masses involved. The consequent lag between drivers creates a disturbance of phase relationships that is now suspected to be the chief cause of "canned," unnatural speaker sound.

All speaker systems produce some time delay distortion, but the Rectilinear XII is superior in this respect to any other bookshelf speaker except the considerably more expensive Rectilinear 5. The tight acoustic coupling of the woofer in the Rectilinear XII, the low crossover to the considerably "faster" low-inertia midrange driver, the unusually low mass of the tweeter and the sophisticated crossover network all contribute to the lowest possible time delay figures throughout the frequency range.

SUMMARY OF SPECIFICATIONS:

Size: 25" x 14" x 10¾" deep
(635mm x 356mm x 273mm)

Drivers: 10" woofer, 5" midrange,
2½" tweeter

Crossover Frequencies: 350 Hz and 4000 Hz

Nominal Impedance: 8 Ohms

Minimum Power Requirements: 10 watts RMS

Maximum Power Handling Capacity:
50 watts RMS

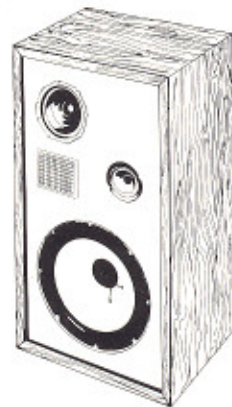
Frequency Response: 45 Hz to 18,500 Hz
± 2 dB

Controls: Separate midrange and
treble adjustments

Connection to Amplifier: Binding posts

Cabinet: One piece construction with
walnut finish

Shipping Weight: 42 lbs. (19.05 kg)



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