University Sound
a MARK IV company

SPECIFICATIONS

Frequency Response:
90-18,000 Hz ±5 dB
(See Figure 1)

Power Handling:
10 watts (EIA RS-426A)

Impedance,
Nominal:
8 ohms
Minimum:
7 ohms (230 Hz)

Sound Pressure Level at 1 Meter, 1 Watt Input, 200-4,000-Hz Average:
91 dB

Voice Coil Diameter:
2.54 cm (1.0 in.)

Magnet Weight:
0.32 kg (0.72 lb)

Magnet Material:
Barium ferrite

Flux Density:
1.0 Tesla

Magnet Frame:
22 ga. stamped steel

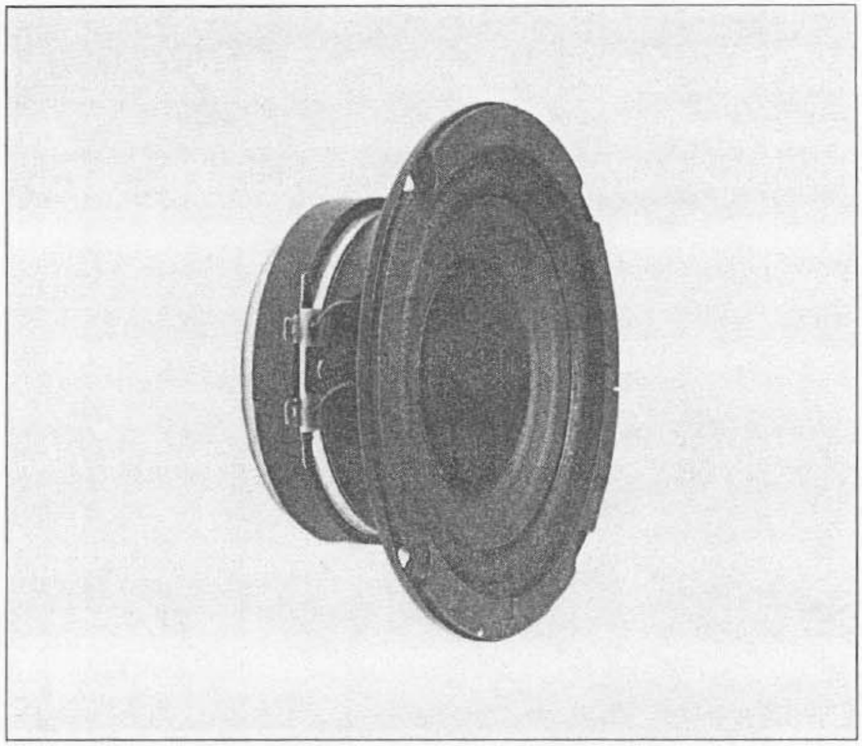
Color, Frame:
Black

Dimensions,
Diameter:
13.2 cm (5.2 in.)
Height:
(CS410) 5.1 cm (2.0 in.)
(CS410T) 10.2 cm (4.0 in.)

Net Weight,
CS410:
0.9 kg (2.0 lb)
CS410T:
1.3 kg (2.8 lb)

Shipping Weight,
CS410:
1.1 kg (2.5 lb)
CS410T:
1.5 kg (3.3 lb)

Transformer Input (CS410T):
25-, 70.7-, or 100-volt line



CS410 CS410T Full-Range Loudspeaker

DESCRIPTION

The University CS410 is a high-quality, 4-inch, full-range loudspeaker for distributed sound systems.

An acoustically transparent dome encloses a small, centrally-mounted free-edge cone which is used to improve high-frequency dispersion.

The CS410 is suitable for use in applications requiring highly intelligible speech or smooth musical reproduction.

To insure long-term reliability in installations, the CS410 is designed to handle 10 watts continuous power (40 watts peak) of shaped white noise signal for eight hours per EIA Standard RS-426A.

The CS410T includes a transformer, allowing connection to 25-, 70.7-, or 100-volt line, with taps of 0.25 to 5 watts.

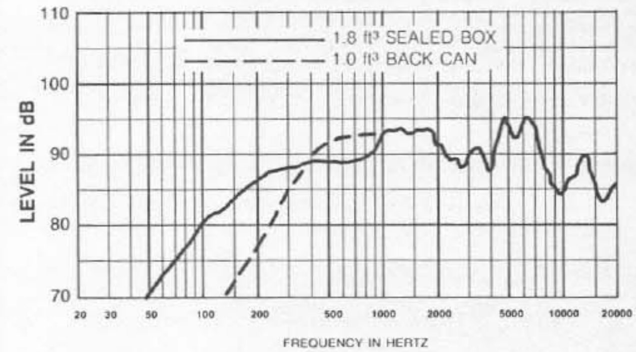


FIGURE 1 — Axial Frequency Response 1 Watt/1 Meter

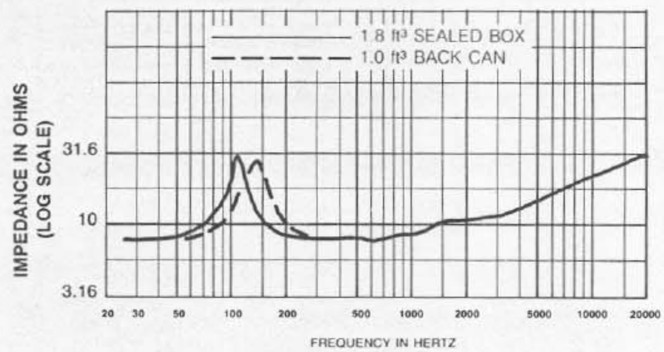


FIGURE 2 — Input Impedance vs. Frequency

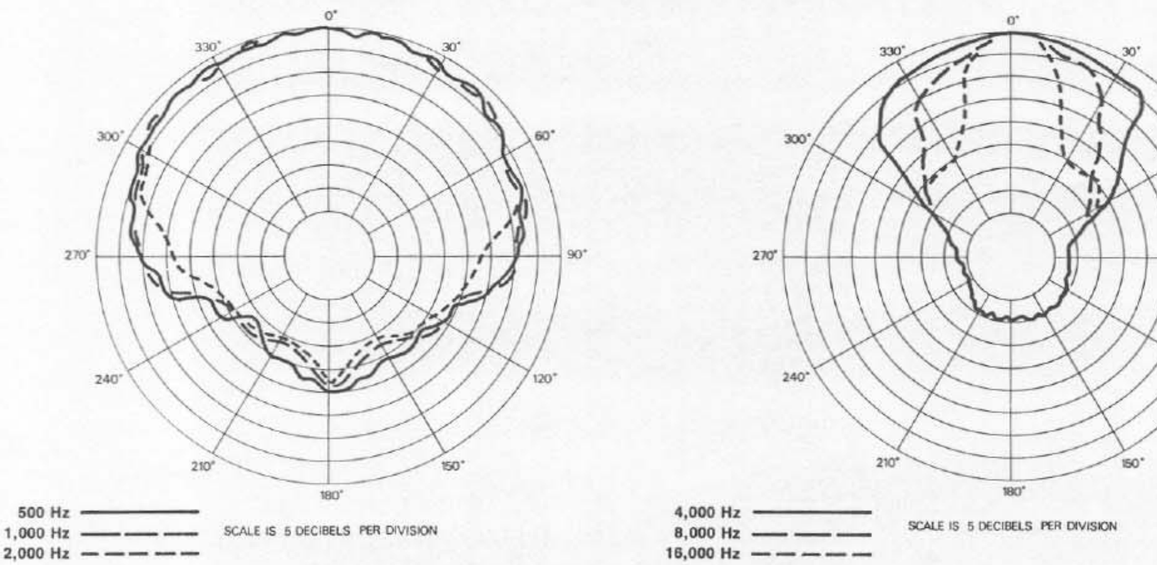


FIGURE 3 — CS410 Polar Response in 1.8 ft³ Sealed Box 4V RMS of ⅓-Octave-Band-Limited Noise in Anechoic Environment, 10 Feet on Axis (5 dB per division)

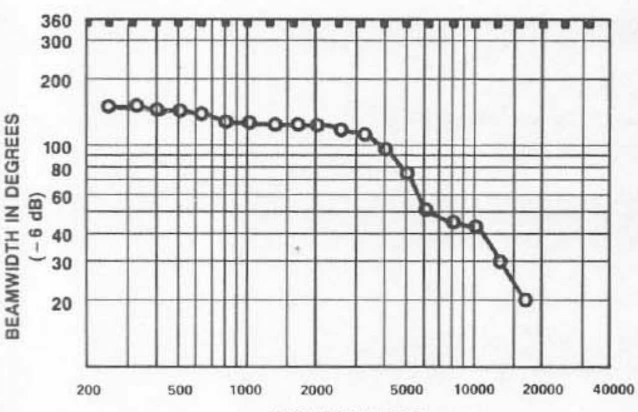


FIGURE 4 — CS410 Beamwidth vs. Frequency in 1.8 ft³ Sealed Box

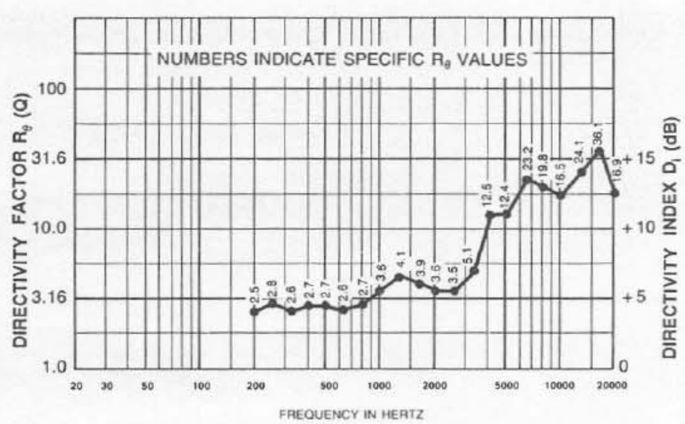


FIGURE 5 — CS410 Directivity Factor and Directivity Index vs. Frequency in a 1.8 ft³ Sealed Box

LINE VOLTAGE	25V	70.7V	100V
CS410T	0.5 W	0.5 W	1.0 W
	1.0 W	1.0 W	2.0 W
	2.0 W	2.0 W	4.0 W
	5 W	5 W	—

TABLE 1 — Rating of Secondary Taps

DIRECTIONAL PERFORMANCE

The directional characteristics of the CS410 in a 1.8 cubic-foot vented enclosure were measured by running a set of polar responses in EV's large anechoic chamber. The test signal was ⅓-octave-band-limited pseudo-random pink noise centered at the ISO standard frequencies indicated in Figure 3.

Additional typical data is provided in Figures 4 and 5 which indicate 6-dB-down beamwidth versus frequency and directivity factor, respectively, for a CS410 in the test enclosure.

POWER HANDLING TEST

The CS410 is designed to withstand the power test described in EIA Standard RS-426A. The EIA test spectrum is applied for eight hours. To obtain the spectrum, the output of a white noise generator (white noise is a particular type of random noise with equal energy per bandwidth in Hz) is fed to a shaping filter with 6-dB-per-octave slopes below 40 Hz and above 318 Hz. When measured with usual constant-percentage-bandwidth analyzer (one-third-octave), this shaping filter produces a spectrum whose 3-dB-down points are at 100 Hz and 1200 Hz with a 3-dB-per-octave slope above 1200 Hz. This shaped signal is sent to the power amplifier with the continuous power set at 10 watts into the EIA equivalent impedance (8.6 volts true RMS). Amplifier clipping sets instantaneous peaks at 6 dB above the continuous power, or 40 watts peak (17.2 volts peak). This procedure provides a rigorous test of both thermal and mechanical failure modes.

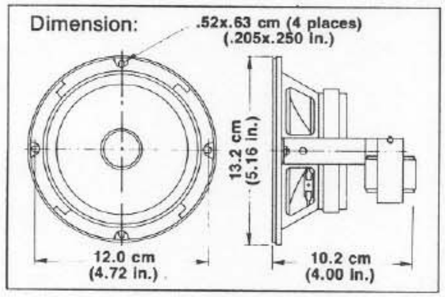
RECOMMENDED CONNECTIONS

The CS410 is a nominal 8-ohm impedance loudspeaker with a 10-watt input capability. However, it is also available with transformer. The CS410T utilizes a 5-watt, 25/70.7/100-volt universal line matching transformer with power taps ranging from 0.25 to 5 watts. The transformer is mounted to the frame and the secondary winding is accessible for the user to select any of the power taps indicated in Table 1. For use with 100 V lines, connect to the 70.7 V primary winding, and use Table 1 above to determine the wattage ratings of the various secondary winding taps. Do not use the tap marked 5 W.

All wattages marked for the various taps refer to the load on the amplifier, with the insertion loss of the transformer being less than 2 dB.

RECOMMENDED ENCLOSURES AND BAFFLES

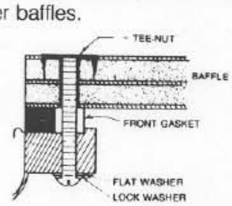
The CS410 and CS410T are designed to fit on standard 4-inch ceiling speaker baffles. Additionally, these loudspeakers will accommodate the use of any standard back enclosure with a diameter of 5.5 inches or greater and a depth of at least 4.5 inches. Larger back volumes will increase the lower



frequency output. The frequency response of a CS410 in typical 1.0-cubic-foot and 1.8 cubic-foot back enclosures are shown in Figure 1.

Mounting:

The CS410 may be rear-mounted and requires a 11.0 cm (4.35 in.) diameter cutout and a 12.0-cm (4.72-in.) bolt circle. Normal fasteners up to 5 mm (0.20 in.) will fit through the eight holes in the frame. The CS410 is designed for mounting on standard ceiling speaker baffles.



ARCHITECTS' AND ENGINEERS' SPECIFICATIONS

The loudspeaker shall be a dual-cone loudspeaker with a nominal diameter of 13.2 cm (5.2 in.), an overall depth of 5.1 cm (2.0 in.), and shall weigh no more than 0.9 kg (2.0 lb). The voice coil shall have a nominal diameter of 2.54 cm (1.0 in.) and depth of 7.6 mm (0.3 in.) and shall operate in a gap of not less than 1.0 T (10,000 Gauss). High frequencies shall be reproduced by 4.0 cm (1.6 in.) free-edge cone attached to the apex of the low-frequency device and protected from dust by a dust dome fastened to the low-frequency cone.

The loudspeaker shall exhibit a sensitivity (SPL, 1 W at 1 m (3.28 ft) averaged 200-4,000 Hz) of no less than 91 dB on axis maintaining an essentially flat frequency response with 3-dB-down points at 165 Hz and 16,000 Hz in a 12-cubic-foot sealed box in a free field. The half-space reference efficiency shall be 0.8%. The nominal impedance shall be 8 ohms and the dc resistance shall be 6.5 ohms. The loudspeaker shall be capable of handling a continuous 10-watt (8.6 volts true RMS) shaped white-noise signal (as per EIA Standard RS-426A) with a 6-dB crest factor for eight hours.

The loudspeaker shall be the University model CS410. When fitted with a transformer that allows connection to 25-, 70.7- or 100-volt systems of 0.25 to 5 watts the loudspeaker shall be referred to as the University model CS410T.

WARRANTY (Limited) — University Sound Speakers and Speaker Systems (excluding active electronics) are guaranteed for five years from date of original purchase against malfunction due to defects in workmanship and materials. If such malfunction occurs, unit will be repaired or replaced (at our ption) without charge for materials or labor if delivered prepaid to University Sound. Unit will be returned prepaid. Warranty does not extend to finish, appearance items, burned coils, or malfunction due to abuse or operation under other than specified conditions, including cone and/or coil damage resulting from improperly designed enclosures, nor does it extend to incidental or consequential damages. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you. Repair by other than University Sound will void this guarantee. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Service and repair address for this product: University Sound, 600 Cecil Street, Buchanan, Michigan 49107. (AC/616-695-6831)

Specifications subject to change without notice.

BASIC GUIDELINES FOR DISTRIBUTED CEILING SPEAKER SYSTEM

Concept. The basic goals for a distributed ceiling speaker system are intelligibility and adequate SPL. Speakers with the proper coverage pattern should be chosen, spaced appropriately and powered to achieve a uniform direct field at listener ear level.

Even Coverage vs. Cost. Uniformity of sound coverage for a ceiling speaker installation increases with greater speaker density, but the cost of the installation also goes up.

Two basic loudspeaker placement patterns are normally used. These are the traditional square and hexagonal patterns as shown in Figure 1. For the square pattern either one side of the square or one diagonal is aligned parallel to one of the room walls. In the case of the hexagonal pattern, one of the diagonals is usually aligned parallel to one of the walls.

For each of the patterns a choice should be made as to the amount of ovelap. These are referred to here as 1) edge to edge, 2) minimum overlap and 3) center to center. These options are also shown in Figure 1. There will be maximum and minimum SPL levels (relative to the on-axis SPL for a single speaker), and the difference between the SPL_{max} and SPL_{min} gives an indication of the quality of the installation.

Table 2 gives typical values for the six basic patterns. A 2-dB (or less) variation in SPL will be virtually imperceptable, whereas a 6-dB variation might be significant, but again may be adequate for many installations. At this stage the installer needs to make a cost vs. quality-of-coverage decision.

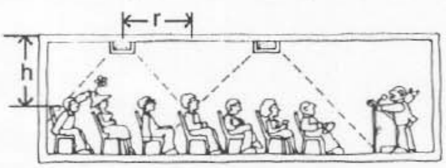
The radius 'r' of the coverage circle is calculated using the formula below, where Ø is the −6 dB beamwidth at the highest frequency of interest and 'h' is the distance between the ceiling and ear level (determined by whether the audience is seated or standing).

$$\frac{r}{h} = \tan\emptyset$$

Example. The CS810 is to be used in an installation requiring speech reinforcement, so an upper frequency limit of 4 kHz is selected, and 'h' is 6 feet. From the beamwidth curve $\emptyset = 45°$.

$$r = \tan\emptyset \times h = 6 \text{ feet}$$

Adequate Headroom. Speakers used in distributed systems almost always use



	L_{max}(dB)	L_{min}(dB)	L_{max}-L_{min}(dB)
Square Edge to Edge	0.66	−3.69	4.35
Hexagonal Edge to Edge	0.95	−4.45	5.40
Square Minimum	2.02	−0.02	2.04
Hexagonal Minimum	1.36	−1.23	2.59
Square Center to Center	5.17	3.78	1.39
Hexagonal Center to Center	5.38	4.21	1.17

TABLE 2 — SPL changes for various patterns relative to on-axis value for a single speaker.

matching transformers in order to econmically distribute amplifier power to each loudspeaker.

It is a simple matter to choose the appropriate transformer tap based upon the average SPL desired, the loudspeaker sensitivity, and the distance between the loudspeaker and the listener. The tap selected for a speaker may vary from room to room; however, the total *average* power required is easily calculated by summing the individual loudspeaker power tap settings.

Be aware that short-term peaks which exist in voice and music, although contributing little to perceived loudness, can be 10 dB or more above the average level. Thus, an amplifier with at least 6 dB (four times) headroom above the simple power summation should be used to avoid distortion on peaks.

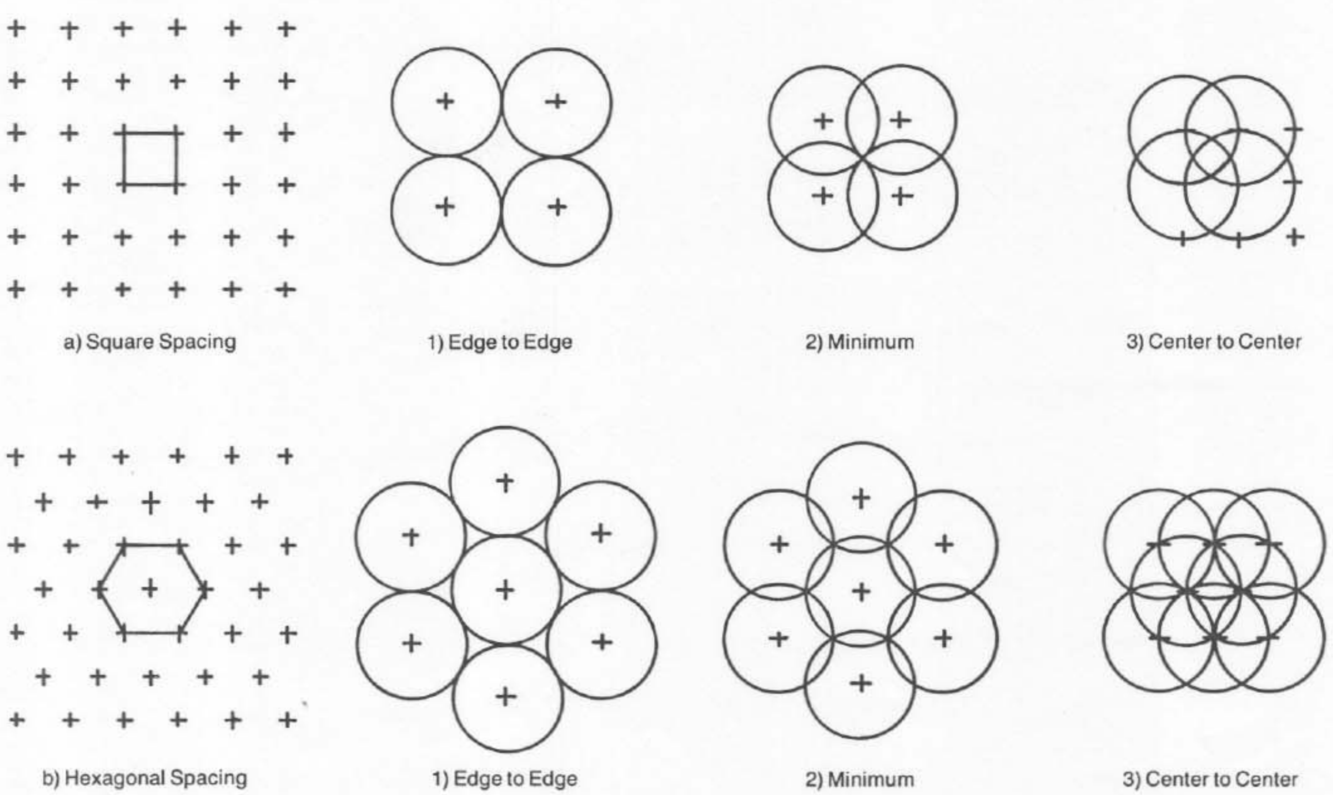


FIGURE 1 — Basic Ceiling Speaker Patterns

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