HARMAN

How To Choose An Enclosure for Your Woofer

AKG by HARMAN harman/kardon by HARMAN Infinity by HARMAN JBL by HARMAN Lexicon by HARMAN Mark Levinson by HARMAN

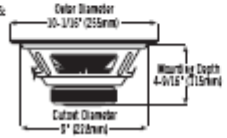
Using the Enclosure Design Sheets

JBL

CS1014 10" Woofer – Technical Data

SPECIFICATIONS

Diameter:	10" (250mm)
Sensitivity (2.83V @ 1m):	90dB
Power Handling:	125W$_{RMS}$ 500W $_{PEAK}$
Frequency Response:	45Hz – 200Hz
Nominal Impedance:	4 Ohms
Voice-Coil Diameter:	1.5" (38mm)
Dimensions:	

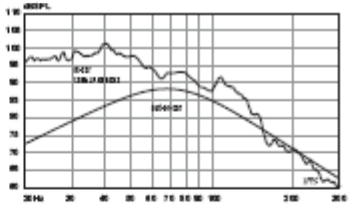


THIELE-SMALL PARAMETERS

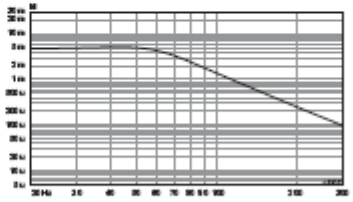
Voice-Coil DC Resistance:	R_{EVC} (ohms)	3.67
Voice-Coil Inductance @ 1kHz:	L_{EVC} (mH)	1.7
Driver Radiating Area:	S_D (in^2)	56.3
	S_D (M^2)	363.00
Motor Force Factor:	BL (Tm)	12.05
Compliance Volume:	V_{AS} (Ft^3)	1.9
	V_{AS} (LITERS)	53.8
Suspension Compliance:	C_{MS} (µM/N)	286
Moving Mass, Air Load:	M_{MS} (GRAMS)	96.00
Moving Mass, Diaphragm:	M_{MD} (GRAMS)	92.6
Free-Air Resonance:	F_S (Hz)	30.00
Mechanical Q:	Q_{MS}	8.34
Electrical Q:	Q_{ES}	0.46
Total Q:	Q_{TS}	0.44
Magnetic-Gap Height:	H_{AG} (IN)	0.3
	H_{AG} (MM)	7.8
Voice-Coil Height:	H_{VC} (IN)	0.83
	H_{VC} (MM)	21
Maximum Excursion:	X_{MAX} (IN)	0.26
	X_{MAX} (MM)	6.6

SEALED BOX VOLUME (INCLUDES DRIVER DISPLACEMENT)

SEALED ENCLOSURE FREQUENCY RESPONSE @ 2.83V



SEALED ENCLOSURE CONE EXCURSION @ 125W



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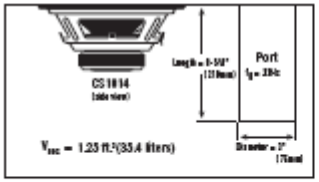
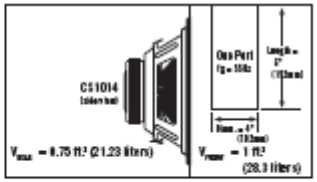
CS1014 10" Woofer – Technical Data

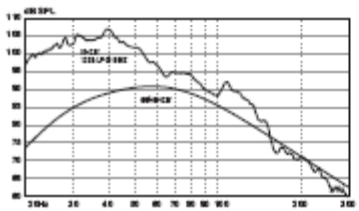
VENTED BOX VOLUME (INCLUDES DRIVER/PORT DISPLACEMENTS)



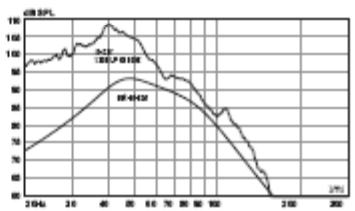
BAND-PASS BOX VOLUME (INCLUDES DRIVER/PORT DISPLACEMENTS)



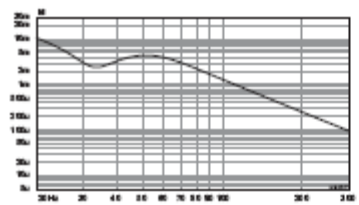
VENTED ENCLOSURE FREQUENCY RESPONSE @ 2.83V



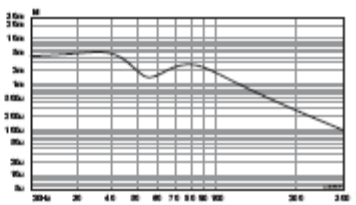
BAND-PASS ENCLOSURE FREQUENCY RESPONSE @ 2.83V



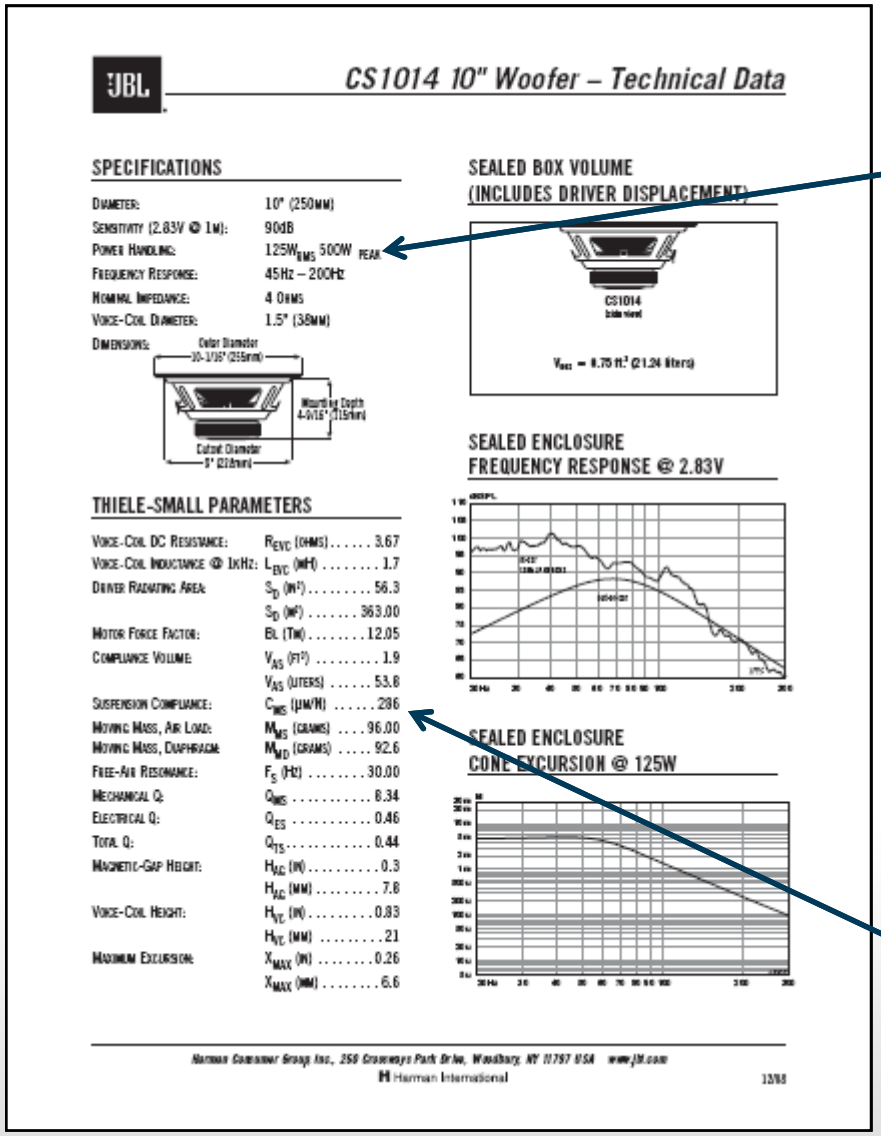
VENTED ENCLOSURE CONE EXCURSION @ 125W



BAND-PASS ENCLOSURE CONE EXCURSION @ 125W



Power Ratings and T&S Parameters



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Diameter:	10" (250mm)
Sensitivity (2.83V @ 1m):	90dB
Power Handling:	125W_{RMS} 500W peak
Frequency Response:	45Hz – 200Hz
Nominal Impedance:	4 Ohms
Voice-Coil Diameter:	1.5" (38mm)
Dimensions:	Cutout Diameter 10-1/16" (255mm); Mounting Depth 4-9/16" (115mm); Cutout Diameter 9" (228mm)

SEALED BOX VOLUME
(INCLUDES DRIVER DISPLACEMENT)

CS1014

V_{BC} = 0.75 ft.³ (21.24 liters)

SEALED ENCLOSURE
FREQUENCY RESPONSE @ 2.83V

SEALED ENCLOSURE
CONE EXCURSION @ 125W

THIELE-SMALL PARAMETERS

Voice-Coil DC Resistance:	R_{EVC} (ohms)	3.67
Voice-Coil Inductance @ 1kHz:	L_{EVC} (mH)	1.7
Driver Radiating Area:	S_D (in²)	56.3
	S_D (m²)	363.00
Motor Force Factor:	BL (Tm)	12.05
Compliance Volume:	V_{AS} (ft³)	1.9
	V_{AS} (liters)	53.8
Suspension Compliance:	C_{MS} (µm/N)	286
Moving Mass, Air Load:	M_{MS} (grams)	96.00
Moving Mass, Diaphragm:	M_{MD} (grams)	92.6
Free-Air Resonance:	F_S (Hz)	30.00
Mechanical Q:	Q_{MS}	8.34
Electrical Q:	Q_{ES}	0.46
Total Q:	Q_{TS}	0.44
Magnetic-Gap Height:	H_{AG} (in)	0.3
	H_{AG} (mm)	7.8
Voice-Coil Height:	H_{VC} (in)	0.83
	H_{VC} (mm)	21
Maximum Excursion:	X_{MAX} (in)	0.26
	X_{MAX} (mm)	6.6

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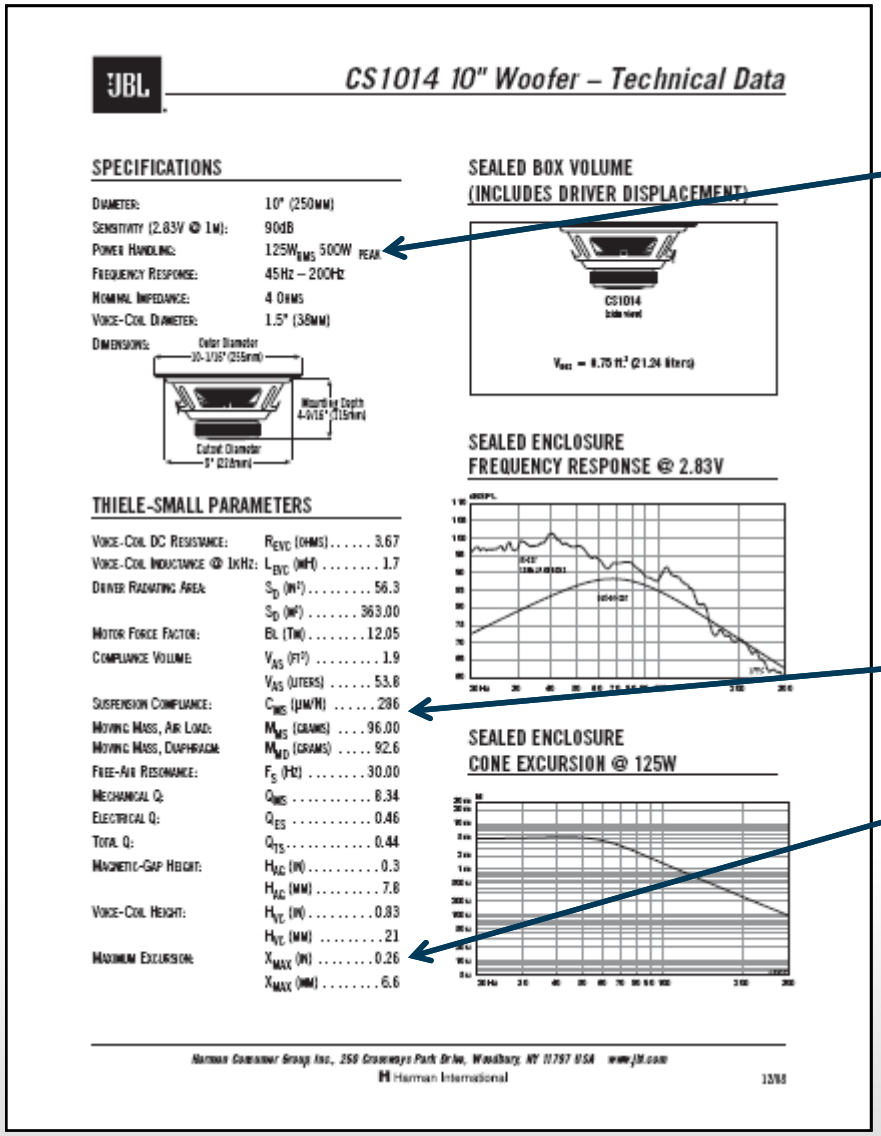
- **These are thermal power handling numbers. These should be used as a guide in choosing an amplifier.**
  - A 500 W RMS amplifier is 4x the power handling rating of the amplifier—too much power.
  - Depending on the box and the customer, you may be able to use an amplifier that provides 2x or 3x the RMS power handling rating.
- **If you want to design your own box using your own computer modeling program, Thiele and Small parameters are included**

Power Handling and Xmax



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Voice-Coil Diameter:	1.5" (38mm)
Dimensions:	Outer Diameter 10-1/16" (255mm); Mounting Depth 4-9/16" (115mm); Cutout Diameter 9" (228mm)

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SEALED BOX VOLUME (INCLUDES DRIVER DISPLACEMENT)

CS1014

V_{AS} = 0.75 ft.^{3} (21.24 liters)

SEALED ENCLOSURE FREQUENCY RESPONSE @ 2.83V

SEALED ENCLOSURE CONE EXCURSION @ 125W

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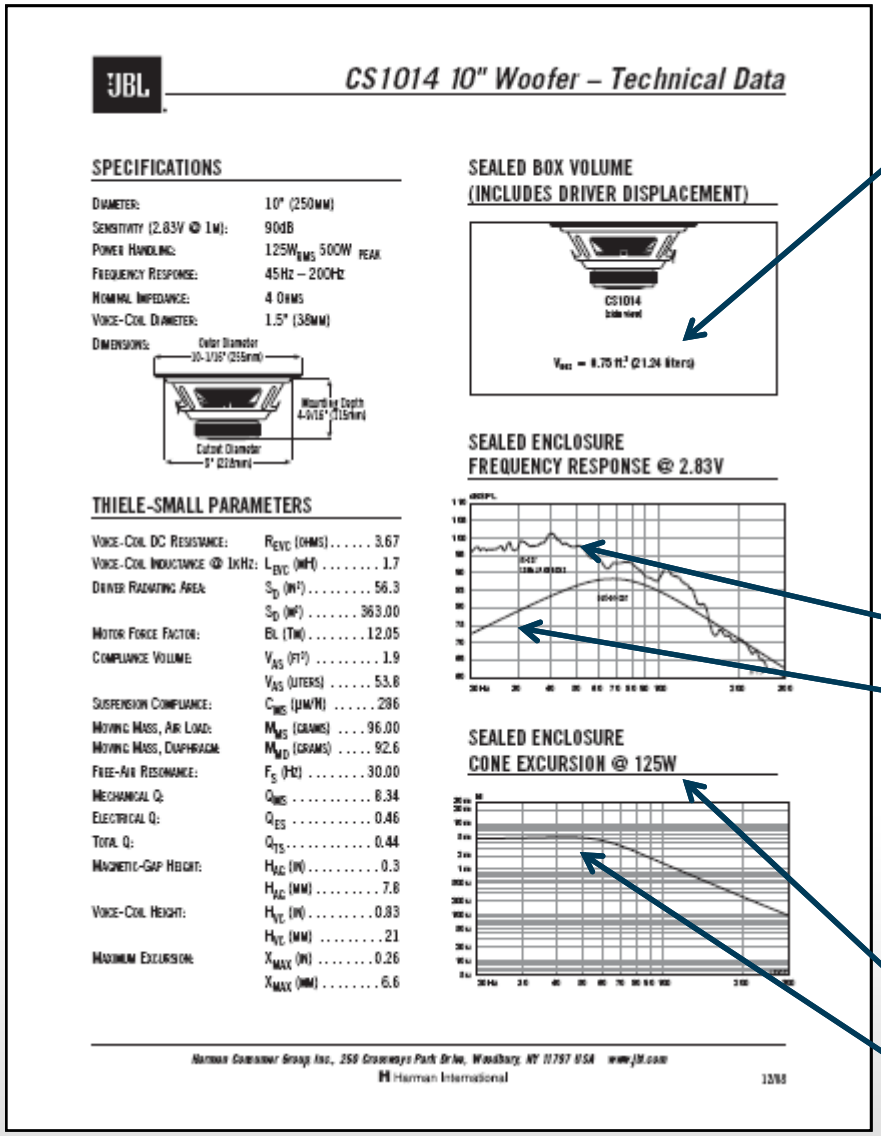
- **These are thermal power handling numbers. These should be used as a guide in choosing an amplifier.**
  - A 500 W RMS amplifier is 4x the power handling rating of the amplifier—too much power.
  - Depending on the box and the customer, you may be able to use an amplifier that provides 2x or 3x the RMS power handling rating.
- **If you want to design your own box using your own computer modeling program, Thiele and Small parameters are included**
- **Carefully consider Xmax (maximum excursion) when you choose your box. It's OK to exceed Xmax by about 20 percent**
  - Xmax is the distance the motor can drive the cone. If you apply much more power than the amount required to reach Xmax, the woofer will be in danger.

Sealed Box Design



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SEALED BOX VOLUME
(INCLUDES DRIVER DISPLACEMENT)

SEALED ENCLOSURE
FREQUENCY RESPONSE @ 2.83V

SEALED ENCLOSURE
CONE EXCURSION @ 125W

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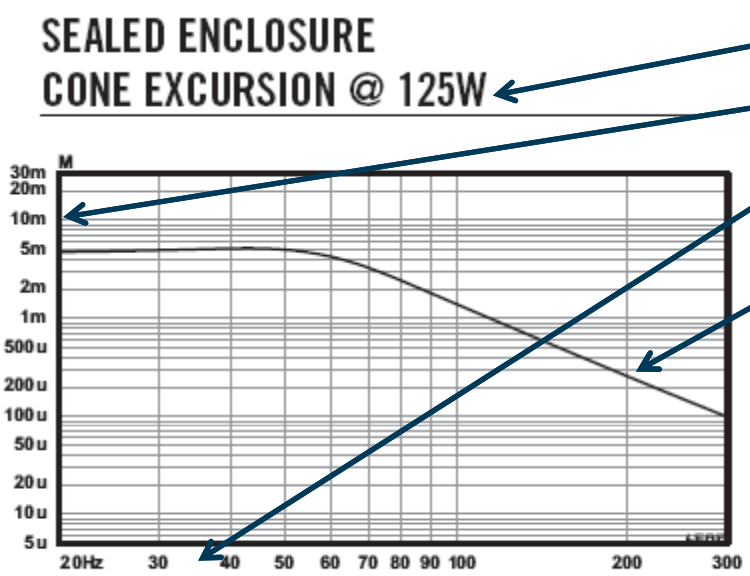
- **This is the suggested sealed box volume.**
  - We suggest stuffing the box with Dacron or fiberglass insulation for best performance.
  - We don't provide the dimensions of the box, because you may want to design a box of a different shape.
- **We provide two frequency response curves so you'll be able to compare this woofer with others and also so you'll know what this box will sound like in the car.**
  - In-car response
  - Anechoic response (for comparing to documentation for other woofers)
  - A low pass filter frequency is suggested here
- **This graph shows how far the cone will move at the frequencies the box will play when a certain amount of power is applied**
  - Applied power
  - Excursion graph

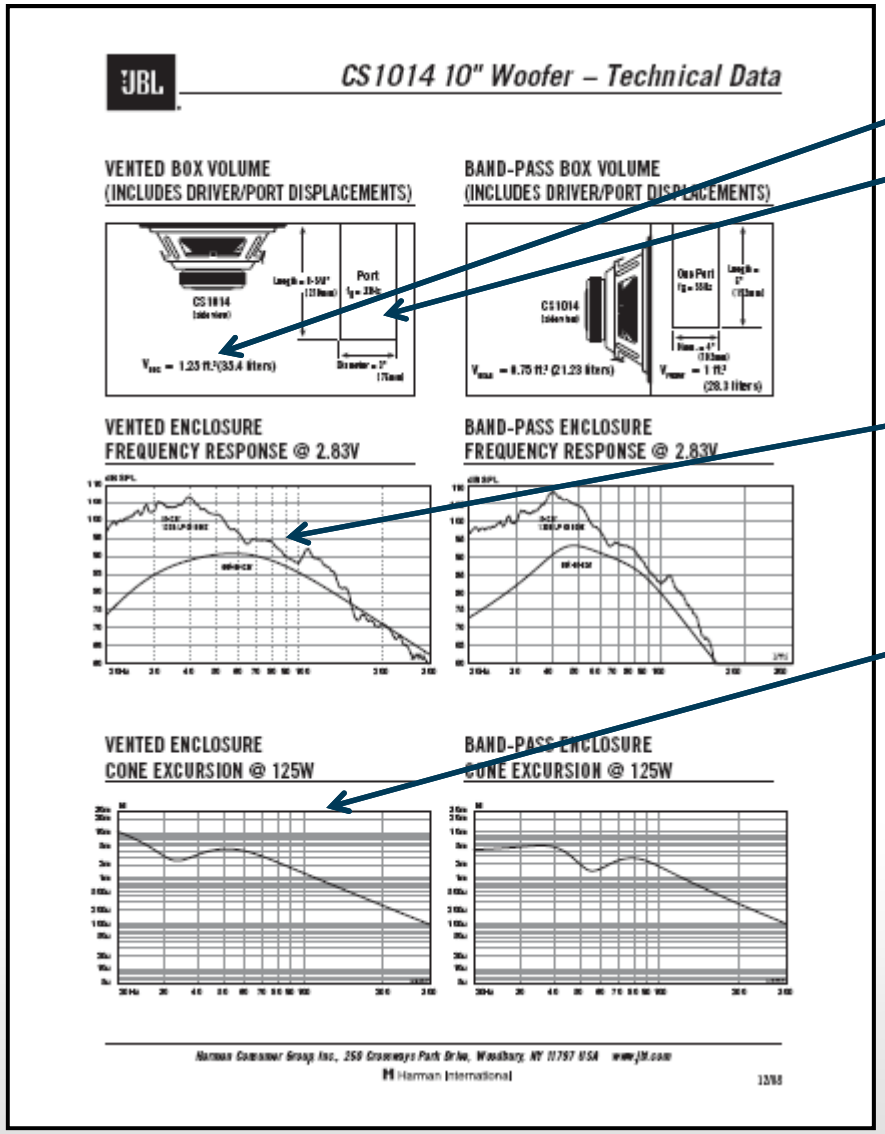
The Excursion Graph in Detail
(Sealed Box)



MAXIMUM EXCURSION:	
	X_{MAX} (IN) 0.26
	X_{MAX} (MM) 6.6

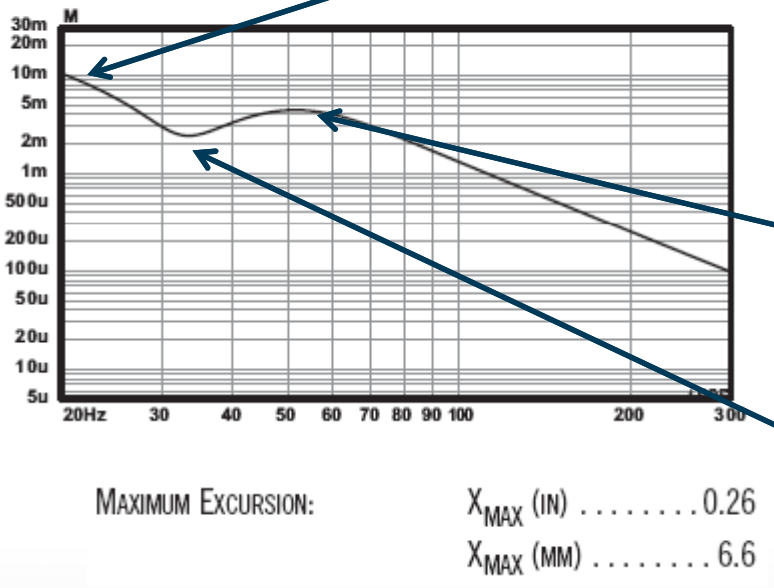
- **This is the amount of RMS power applied**
- **This is the distance the cone will move**
- **This is the frequency scale**
- **This graph shows how far the cone will move at the frequencies the box will play when a certain amount of power is applied**
  - In a sealed box, excursion is greatest at low frequencies.
  - This graph shows that in a sealed box, 125 W RMS will ALMOST drive the woofer to Xmax. The graph shows about 5.5mm of excursion at 125 WRMS
  - It's OK to apply a little more power than RMS because it's OK to exceed Xmax by about 20 percent.
  - For a bass-enthusiast who will listen as loud as possible, a 150 Watt amplifier is about the right amount of power.

Vented Box Design



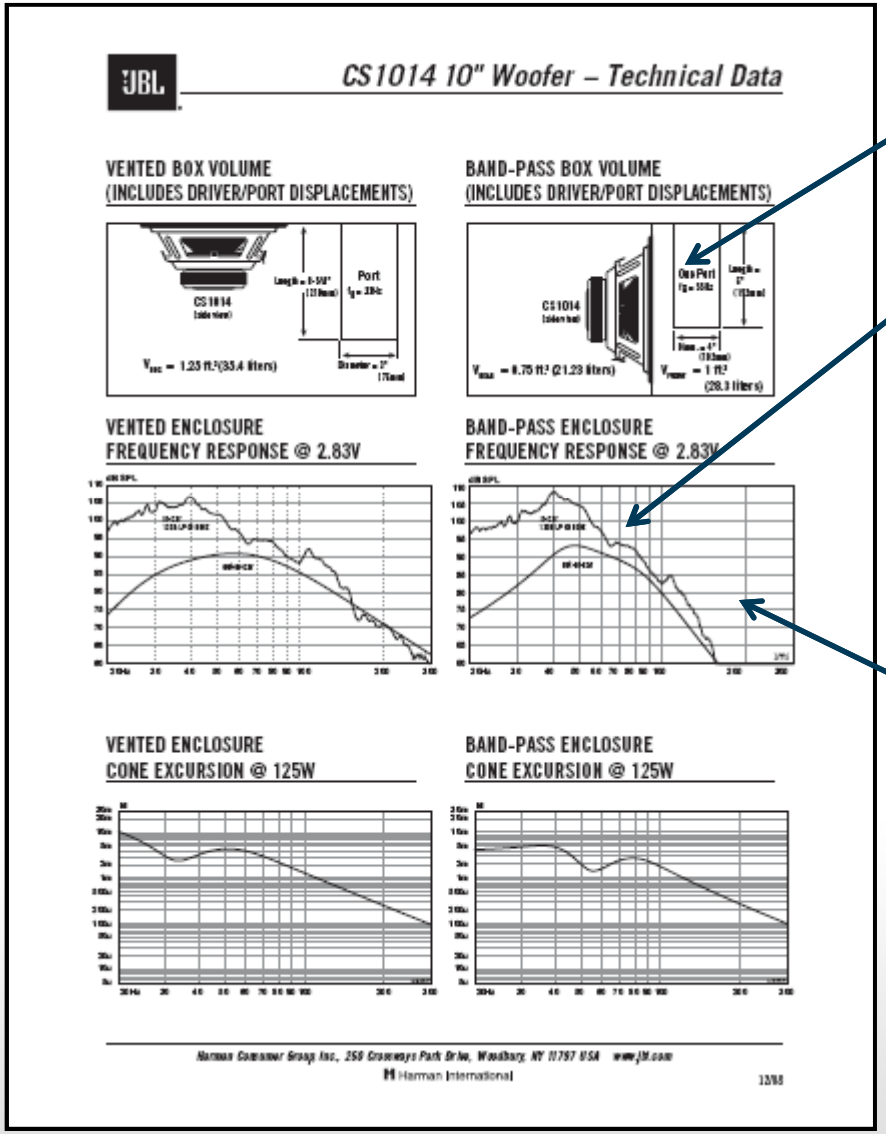
- **This is the suggested vented box volume.**
- **These are the suggested dimensions of the vent and the frequency at which the box will be tuned.**
  - We recommend round ports—they sound better.
- **In-car and anechoic frequency response curves**
  - Notice that the vented box plays louder in the car than the sealed box.
- **Excursion graph for the vented box**
  - Notice that the shape of the excursion graph is different than that of a sealed box.

The Excursion Graph in Detail
(Vented Box)



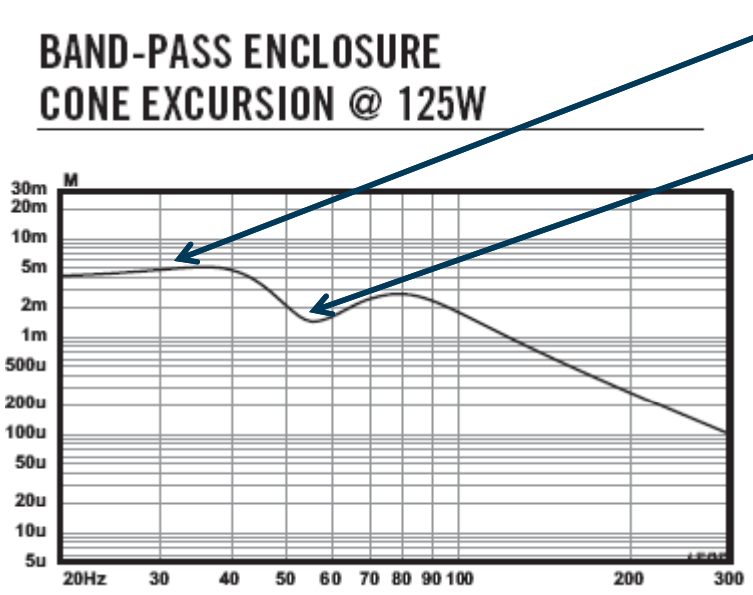
- **At 125 Watts, excursion exceeds Xmax, but only at the very lowest frequencies**
  - A subsonic filter should be used and should be set to a frequency a little lower than Fb (you can find Fb on the previous page). 30Hz is a good point to use.,
  - The subsonic filter will reduce the power at the lowest frequencies and REDUCE the excursion.
- **At frequencies above Fb, 125 Watts only drives the woofer to about 4mm excursion.**
  - More power can be used on the vented box, so long as a subsonic filter is applied.
- **Cone excursion is REDUCED at the frequency where the port plays.**
  - The woofer doesn't move as far because the pressure inside the box is MUCH higher at Fb. Most of the sound comes from the port.
- **A vented box will play LOUDER than a sealed box *and* It will handle More Power.**
  - A vented box is a MUCH better choice, if the customer will devote the additional space for the box.

Bandpass Box Design



- **Box volumes and port dimensions**
  - We recommend round ports—they sound better.
- **Bandpass boxes perform like sealed boxes with a low pass filter.**
  - The port only allows low frequencies to pass through it.
  - The bandpass box will make a big peak in the car
  - Bandpass boxes are big
  - Bandpass boxes are more difficult to build
  - Only use a bandpass box as a last resort
- **In-car and anechoic frequency response curves**
  - Notice that the bandpass box has a big peak in the response, but less low bass than the vented box.
- **Excursion graph for the bandpass box**
  - Excursion is reduced at Fb, but the woofer has to move a lot at low frequencies

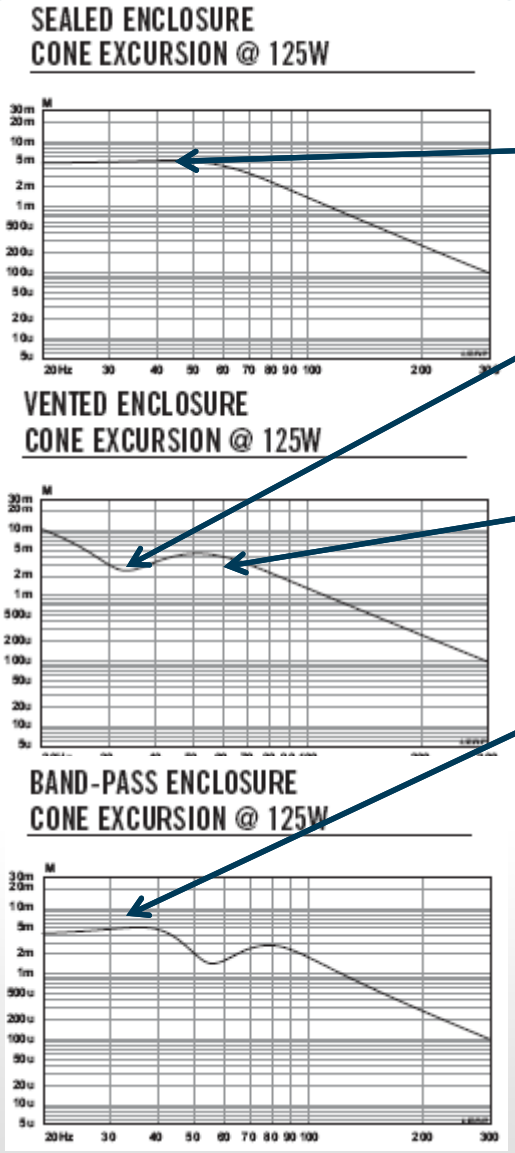
The Excursion Graph in Detail
(Bandpass Box)



MAXIMUM EXCURSION:	X_{MAX} (IN) 0.26
	X_{MAX} (MM) 6.6

- **At 125 Watts, the bandpass box is similar to the sealed box at low frequencies**
- **Cone excursion is reduced at Fb, but that reduction is as useful as it is in a vented box because the frequency is MUCH higher.**
- **Bandpass boxes handle about the same amount of power as a sealed box.**
- **A vented box will play LOUDER than a bandpass box *and* It will handle More Power.**
  - A vented box is a MUCH better choice than a bandpass box.
  - Bandpass boxes are usually even larger than a vented box.

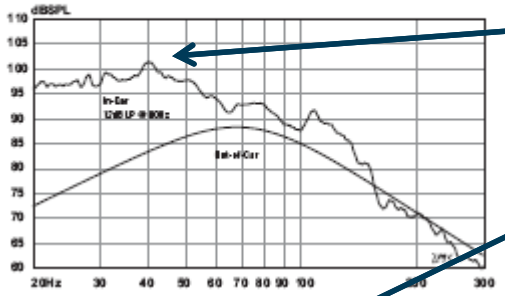
Comparing the Woofer's Excursion in the Three Boxes



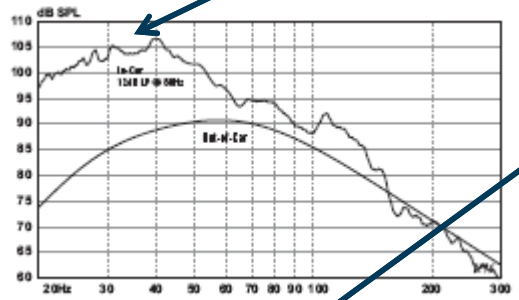
- The sealed box requires the same excursion at all useful frequencies
- The vented box reduces excursion at the frequency where the box is tuned (Fb). Adding a subsonic filter (included in most JBL amplifiers) minimizes excursion below Fb
- Once the subsonic filter has been set, excursion in the vented box is LOWER than in the sealed box with the same amount of power. This means it's OK to apply more power!
- The bandpass is similar to the sealed box at low frequencies
- The bandpass box minimizes excursion at higher frequencies, but it isn't very useful.

Comparing the Sound of the Three Boxes

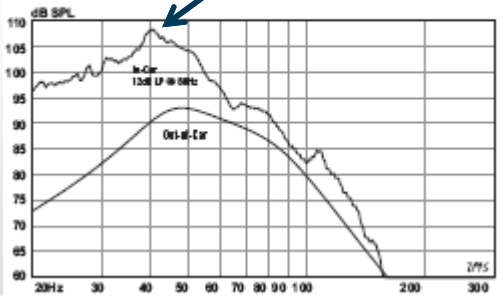
SEALED ENCLOSURE
FREQUENCY RESPONSE @ 2.83V



VENTED ENCLOSURE
FREQUENCY RESPONSE @ 2.83V



BAND-PASS ENCLOSURE
FREQUENCY RESPONSE @ 2.83V



- The sealed box has a flatter response in the car
- The vented box plays almost 6dB louder with the same power as the sealed box! That's equivalent to four times the amplifier power.
- More amplifier power can be applied to the vented box than the sealed or bandpass box! Double the RMS power rating is often OK. That's 9dB louder in the car!
- The bandpass box plays louder than the vented box, but only at one frequency.
- Vented boxes are ALWAYS the best choice for best sound if the customer can devote a little more space.

Conclusions

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- Sealed boxes are small, but they don't play very loudly.
- Sealed boxes require woofers with high Xmax ratings in order to handle lots of power.
- Vented boxes make much more bass and even more power can be applied.
- Vented boxes are bigger than sealed boxes.
- Woofers designed specifically for vented boxes often have low Xmax ratings.
- Bandpass boxes have one good feature—a big peak in the response of the car, but they're bigger than the other boxes and more difficult to build. Stay away from bandpass boxes, unless there's a really good reason to build one.
- Almost all JBL and Infinity woofers are designed to be used in sealed and vented boxe. Most have big Xmax ratings (greater than 10mm)
- The only exception is the CS1014. It was designed SPECIFICALLY for a vented box. You can use it in a sealed box, but only with a small amplifier .

WHERE SOUND MATTERS

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