CROSSFIRE
CAR AUDIO

OWNERS MANUAL FOR C3 SUBWOOFERS

Thanks for buying our product! Product information follows; please read it carefully to get the most out of your subs. Any questions, you can **contact technical support**:
Phone 972-570-0800; email Tech@crossfirecaraudio.com
Para asistencia en Espanol: Techsp@crossfirecaraudio.com
Enjoy!

Subwoofer Power Ratings:

Power handling for subwoofers depends on the use conditions. How loudly you play what type of music and how hard you drive the amplifier are more important than any numbers-but of course, some kind of numeric guideline is necessary for convenience. Therefore, Crossfire rates as follows:
Nominal power handling: this amount of RMS amplifier power should not cause damage to a subwoofer in a recommended enclosure-so long as the amplifier is not clipped.*
Maximum Power Handling: this amount of RMS amplifier power driving the sub at maximum volume continuously could cause damage over time. Should be used with caution, and without clipping the amp.

Notes On Amplifier Power:

The important rating of an amp is RMS power. IF this spec is not exaggerated, it is how many watts the amp can output continuously without distortion. Other specs ("peak"; "maximum") are not very meaningful in most cases. How does this match a subwoofer's power rating? Read on...

Notes On Subwoofer Limits:

Subs have two limitations: mechanical and thermal. Crossfire combines these into the ratings explained at top.
Thermal power handling of the woofer is basically how many watts you can pump into it before it burns or melts:
- Amps' RMS power similar to the subwoofers' rating: should be a good match providing the amp is not clipped.
- Amps' RMS power much more than subwoofers' rating: could damage the sub unless gains are carefully set to prevent the amplifier ever clipping.
- Amps' RMS power much less than the subwoofers' rating: could still damage the sub if the amp is clipped.
Mechanical power handling means how far the cone can move before physical parts hit or deform ("bottoming out"). At very low frequencies, it does not take much power to move the subwoofer cone a lot, so even low powered amplifiers could damage the sub. The enclosure affects how easy it is to hit the mechanical limits; please see notes on a later page.

*Amplifier Clipping And Dead Subwoofers:

When "clipped" the amplifier tries to put out more power than it is capable of, and the output waveform flattens out, no longer following the music. Viewed on an oscilloscope, it looks like the music waveform has had the tops "clipped off" with scissors. Under these conditions, an amplifier could put out over twice its rated RMS power, causing a subwoofer to overheat. Additionally, a clipped amplifier can generate DC currents which will drive the subwoofers coil out of position: it may burn &/or hit mechanical limits more easily. A clipping amp will sound highly distorted and crackly. A sub hitting its mechanical limits tends to sound like a jackhammer or woodpecker. These sounds often indicate damage could be imminent.
- Bottom line? If it sounds not merely loud but nasty, TURN IT DOWN before something breaks!

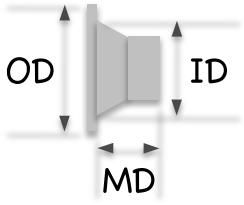
Specs, Dimensions, and Enclosures

Thiele-Small Parameters: these vary from unit to unit and also according to measurement technique, so don't get too hung up on exactness of the numbers or box design results. By the way, "pk-pk" means peak-to-peak. The shape parameters are for the LEAP simulator; they allow better prediction of the upper frequency response.
Sensitivity (n_o): this spec is omitted because it is for mid frequencies and misleading for subwoofers.
Woofer displacement volume: for a drop-in mounting, this is balanced by the size of the cutout and can be ignored. For "backwards" mounting, a good approximation is to calculate the volume of the cutout and double it.

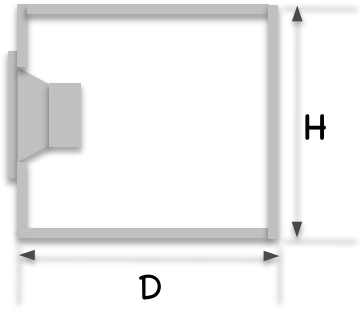
Vance Dickason's *Loudspeaker Cookbook* contains tons of useful information and we highly recommended it.

Model:	C3 10S	C3 10D	C3 12S	C3 12D
Nominal Size	10"	10"	12"	12"
Outer Diameter (OD)	10.75"/273mm	10.75"/273mm	12.6"/320mm	12.6"/320mm
Inner Diameter (ID)	9.2"/234mm	9.2"/234mm	11"/280mm	11"/280mm
Mounting Depth (MD)	4.75"/121mm	4.75"/121mm	5.5"/138mm	5.5"/138mm
Power Handling, RMS	250 Watts	250 Watts	250 Watts	250 Watts
Power Handling, Max	500 Watts	500 Watts	500 Watts	500 Watts
Magnet	40 oz	40 oz	40 oz	40 oz
Voice Coil	2" Aluminum	2" Aluminum	2" Aluminum	2" Aluminum
Nominal Impedance (Z)	4Ω	Dual 4Ω	4Ω	Dual 4Ω
D.C. Resistance(Re)	3.2Ω	1.6Ω(paralleled)	3.2Ω	1.6Ω(paralleled)
Resonance Frequency (Fs)	32	32	30	29
Total Q (Qts)	0.45	0.52	0.52	0.57
Mechanical Q (Qms)	3.28	3.64	2.87	3.73
Electrical Q (Qes)	0.53	0.61	0.63	0.67
Stiffness (Vas)	1.48ft^3/42L	1.48ft^3/42L	2.58ft^3/73L	3.18ft^3/90L
Excursion (Xmax)	0.24"/6mm pk-pk	0.24"/6mm pk-pk	0.24"/6mm pk-pk	0.24"/6mm pk-pk
Cone Area (Sd)	55.8in^2/360cm^2	55.8in^2/360cm^2	80.6in^2/520cm^2	80.6in^2/520cm^2
Krm/Erm (Z Shape)	22.7/0.69	7.8/0.7	25/0.69	13.4/0.66
Kxm/Exm (Vas Shape)	45.2/0.64	24.9/0.6	40.3/0.66	32.6/0.58

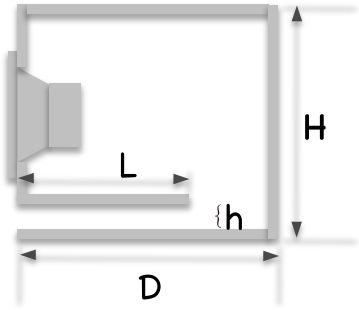
Sub Dimensions



Sealed Box



Ported Box



Box Design Notes

Sealed Versus Ported Boxes:

Sealed Boxes offer the most protection from mechanical damage, plus can offer the most accurate sound quality if not undersized. Exact size is not too critical and can be adjusted by stuffing (see below). Response decreases gradually at low frequencies giving a nearly flat frequency response in many vehicles. But, there's no path for heat to escape from the box (one reason for mounting "inside out").

Ported (Vented) Boxes do offer some heat ventilation. Sound quality is less accurate, but often more powerful. The trade-off: more powerful sound is often boomier. At frequencies below the port tuning, the enclosure does not restrict cone motion. Therefore, music with very low frequencies can bottom out the sub, possibly causing damage. Also, the frequency response rolls off quickly, because the port stops functioning like a port and becomes more like a huge leak-the front and back waves from the sub start to simply cancel each other. If possible, build the box so you can do test listening before final assembly. You can then adjust the port length to taste. If it sounds too boomy after final assembly, you can experiment with stuffing, but not near the port or cone or magnet vents.

Box Stuffing: dense stuffing changes the thermal properties of the enclosure, and can make the enclosure act larger than the measured dimensions. This means sealed boxes can be made somewhat smaller with the same sound. For example, stuffing with 1 pound (1/2 kilo) of 100% polyester such as pillow stuffing could let you shrink the sealed box 15% but keep basically the same sound. Ported boxes cannot take advantage of this effect very well, since stuffing the enclosure can negatively affect the air flow in and out of the port. Coating the inside walls with anti-vibration compounds or sheeting can improve the sound, as can bracing the enclosure.

Ports: Air in the box resists compression, like a spring. The port makes a kind of plug of air, with a certain mass. The system resonates, kinda like how a car bounces up and down on its springs. A longer port has more mass, lowering the tuning. A bigger port also has more mass, but the larger area changes how much box stiffness the port "sees" and tuning goes up. To compensate, the port can be lengthened. BUT the port needs to be big enough to match the cone excursion. Unfortunately for autosound buffs, this all means that a round port big enough to flow all the air often can't fit in the box! And, ports should NOT be built with elbows, it kills the airflow.

Shelf ports, where the port uses one wall of the box, help get around this problem (see diagram). To accommodate a big enough port, the box ends up being deeper than wide. It will not cause any problem to mount the woofer another side of the enclosure, so long as the outside end of the port can breathe very freely. You can adjust shelf port tuning by gluing in thin sheets of material to reduce height-but 2-3 mm at most or you'll cut airflow.

Port radius: rounding the port ends reduces distortion at lower volumes. At high SPL, the air just "jets" in and out and the radiusing has little effect. (For shelf ports, the shape is different, so do radius the inside end if you can).

Recommended Sealed Boxes

Model:	C3 10S	C3 10D	C3 12S	C3 12D
Internal Volume	0.75ft^3	0.75ft^3	1.25ft^3	1.25ft^3

Recommended Ported (Vented) Boxes

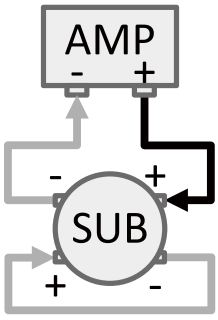
Model:	C3 10S	C3 10D	C3 12S	C3 12D
Internal Volume	1.25ft^3	1.25ft^3	2.0ft^3	2.0ft^3
Port Tuning Frequency	32Hz	32Hz	32Hz	32Hz
Port Area	7 sq inch/3" Round	7 sq inch/3" Round	12.5 sq inch/4" Round	12.5 sq inch/4" Round
Port Length	12.5"	12.5"	13.5"	13.5"

Crossfire recommends the use of Precision Ports™ for all round port applications. Precision Ports™ will increase SPL and reduce airflow turbulence at the entrance and exit of the port with its unique flare port design.

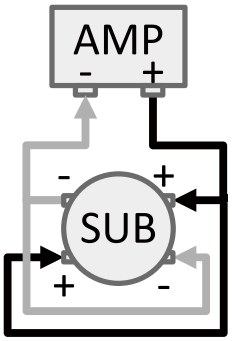
Dual Voice Coil Wiring Options

Speaker wiring comment: for each individual sub, it doesn't matter if you wire the coils in series or parallel. However, don't wire in series with other subs-that results in less than optimum power sharing and sound. Likewise, don't wire just one coil of a dual coil setup. For single coil subs, ignore the bottom wire in the diagrams below.

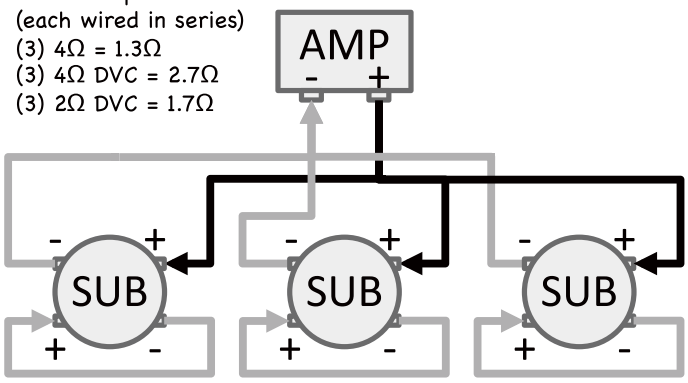
1 Sub-Series
4Ω DVC = 8Ω
2Ω DVC = 4Ω



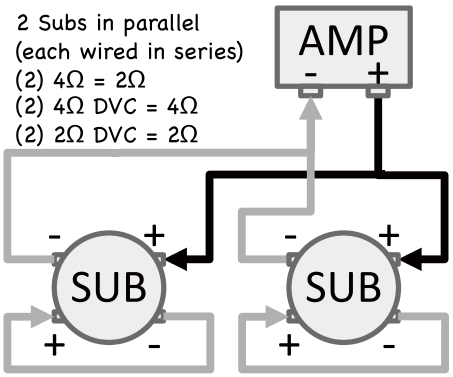
1 Sub-Parallel
4Ω DVC = 2Ω
2Ω DVC = 1Ω



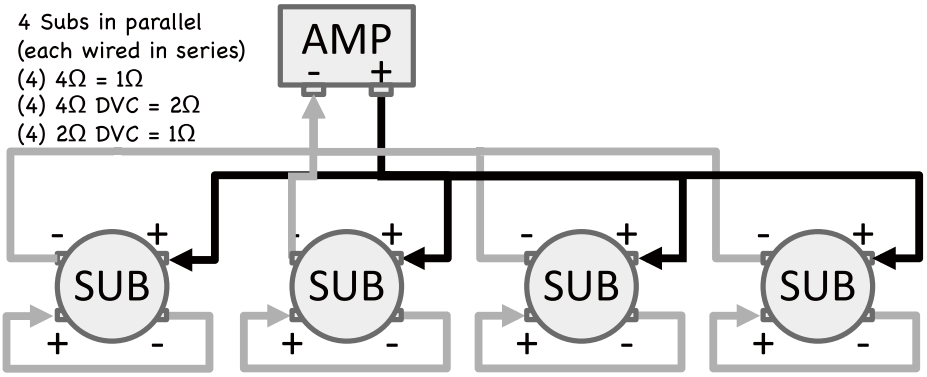
3 Subs in parallel
(each wired in series)
(3) 4Ω = 1.3Ω
(3) 4Ω DVC = 2.7Ω
(3) 2Ω DVC = 1.7Ω



2 Subs in parallel
(each wired in series)
(2) 4Ω = 2Ω
(2) 4Ω DVC = 4Ω
(2) 2Ω DVC = 2Ω



4 Subs in parallel
(each wired in series)
(4) 4Ω = 1Ω
(4) 4Ω DVC = 2Ω
(4) 2Ω DVC = 1Ω



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3247 Story Rd. West, Irving TX. 75038
Tel: 800-332-2771 / 972-570-0800 / Fax: 972-570-2200
www.crossfirecaraudio.com