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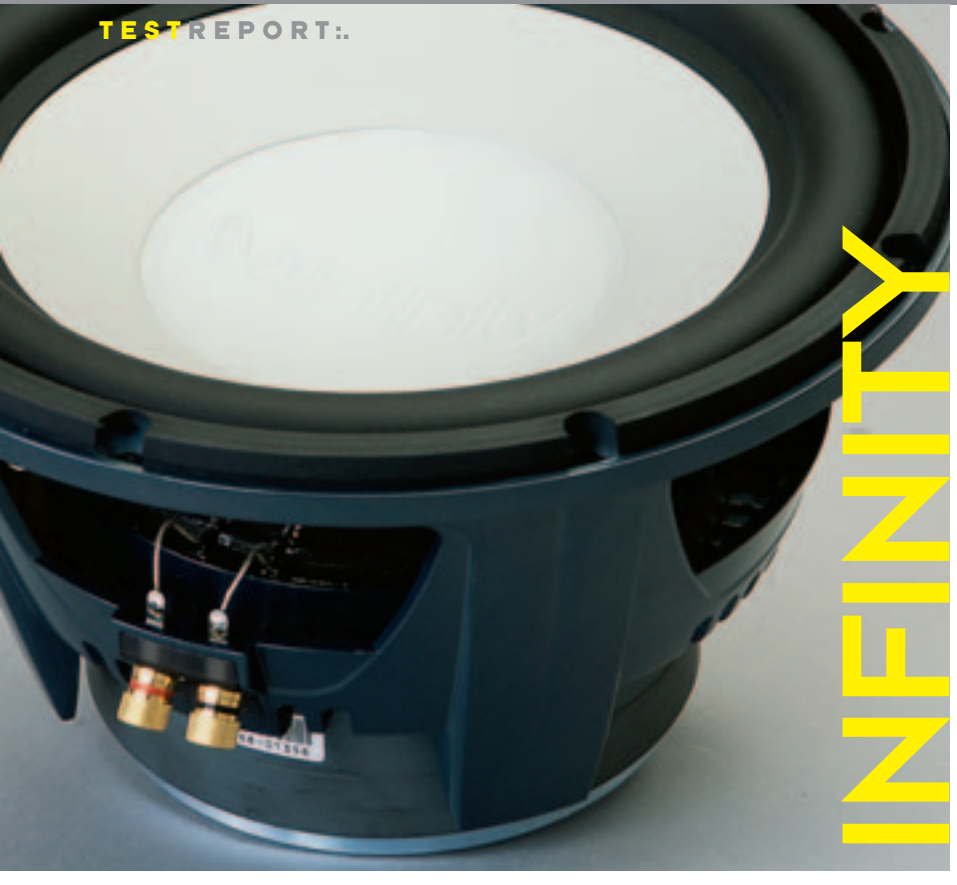


KAPPA PERFECT 12d VQ SUBWOOFER

Variable Q Makes This An Extremely Versatile Sub

TEXT > VANCE DICKASON & ERIC HOLDAWAY :: PHOTOGRAPHY > STEVE SAWITZ

Kappa Perfect was conceived and introduced in 1998 as a high-end line of car audio products. Infinity's claim in 1999, when Kappa Perfect Subwoofers were originally released, was that it had the longest one-way linear excursion of any subwoofer on the market. Additionally, Kappa Perfect subwoofers incorporated a somewhat higher Qts than other sealed-box woofers available at the time, which made them appropriate for use in small sealed and vented boxes. The Perfect 12d VQ represents the latest generation of "Perfect" (no modesty here) subwoofers.

Built on a proprietary four-spoke cast frame design, the dual voice coil 12d VQ weighs in at a healthy 22 lbs. The frame is well conceived and has four sets of vents below the spider that provide for substantial airflow out of the top plate voice coil/gap area. This cooling mechanism is further enhanced by the heat sinking aspect of the frame. Besides cooling, the frame is also set up to provide for substantial rearward spider travel and has nearly 1.5 inches from the integral spider mounting shelf to the back of the frame.

The motor system used on the 12d VQ is pretty unique and patent pending. "VQ" stands for Variable Q. Virtually all woofers you see reviewed in *CA&E* have a fixed Q (short for Qts, the number used to describe low-frequency performance of a speaker). Infinity engineers, however, came up with a clever way to allow a user to personally customize and optimize the Q of his subwoofer for specific applications from small sealed boxes to larger vented or bandpass boxes and even infinite baffle applications. This is accomplished with a system of magnetically conductive 2.5-inch-diameter milled steel "inserts" that fit into the pole piece area of the backplate, which is a milled T-yoke type with a 3mm pole extension. Two inserts marked Mid Q and Low Q are supplied with the Infinity

12d VQ that allow for the three possible variations, High Q (no insert), Medium Q and Low Q. High Q (a Qts of about 0.6) is attained by using no insert at all and just having a gaping 2.5-inch hole in the back of your woofer. The Mid Q insert (Qts in the 0.47 range) is the shortest of the two. It's only 1.875 inches long and has a 1.125-inch-diameter pole vent. For Low Q alignments (Qts about 0.32) you need to install the largest of the two inserts. It measures about 2.875 inches in length and has a smaller pole vent that is only 1 inch in diameter. Since the two steel inserts are magnetically conductive, getting them in and out of the motor backplate would be a serious challenge had Infinity not provided an insert "puller" tool. The tool is a sort of wire handle with ends that fit into two small holes in the sides of the pole vent area. For the technically curious, the inserts affect the measured Qts of this woofer in two ways. First, Qts of a woofer is a primary function of the motor strength (usually described by the Bl number you see in the data charts). The stronger the motor, the lower the Qts (it's not quite that easy, but kind of). The Low Q insert is the longest with the smallest vent and therefore has the most magnetically conductive material added to the motor system. This increases the amount of magnetic flux available to voice coil gap (think of it as a nitrous tank for your woofer). Likewise, the Mid Q insert has less conductive material because it's shorter and has a bigger pole vent, so produces somewhat less magnetic gap flux and results in a Qts higher than the Low Q insert. The High Q setting comes from no insert at all, which means less magnetic flux and thus a higher Qts number. The other affect is really secondary and concerns the amount of series resistance caused by the air flow restriction out the pole, which in turn affects the speaker's compliance in free air.

Horsepower for this ride is provided by two stacked magnets, sandwiched between the milled and polished 10mm-thick front and back plates. Together the plates and magnets create the magnetic field that drives the 3.2-inch-diameter voice coil. The voice coil consists of two 2-layer CCAL (copper clad aluminum) round wire windings on a non-magnetically conductive Kapton former. Engineering at Infinity is pretty much state-of-the-art and the company used a good deal of computer software to design this motor system. This included a FEA (Finite Element Analysis)

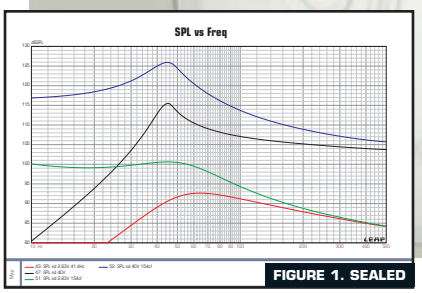


FIGURE 1. SEALED

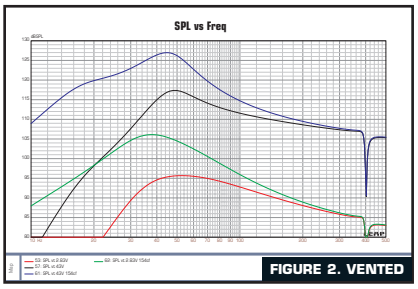


FIGURE 2. VENTED

modeling program called Maxwell, LEAP CAD software like I use in *CA&E* reviews, the MLSSA fft analyzer and the relatively new and very serious big gun for analyzing woofer large signal performance, the Klippel analyzer.

All of this drives a new proprietary metal cone made from a magnesium alloy Infinity calls M³D or Magnesium Metal Matrix Diaphragm. According to the literature, this material is 20 times "deader" than aluminum cones and has superior stiffness and damping compared to other materials. With a 5-inch-diameter dust cap made from the same material that reinforces the cone at its midpoint, the slightly curved M³D cone is indeed quite stiff. However, I was surprised that the outside rim wasn't turned downward, which is often seen with aluminum cones and also enhances their stiffness. I'm guessing this has to do with the bending quality of the magnesium compound.

Part of the compliance for this woofer is supplied by a fairly wide (1 inch) nitrile-butylene-rubber (NBR) injection-molded surround with integral front mounting gasket. Remaining compliance is provided by a 7-inch-diameter polyester and cotton blend progressive roll spider with the voice coil tinsel lead wires stitched to its surface. And lastly, each voice coil is terminated by a pair of gold, color-coded binding posts.

IN THE LAB

As promised in my last review, this review incorporates the use of the new LinearX LEAP 5.0 Enclosure Shop large signal parameter calculation and simulation technology. Equipment used was similar to previous reviews, but has a couple of important changes. The same LinearX LMS analyzer with Windows software was used to make both free-air and added mass impedance measurements. And, as before, this was not done using standard impedance techniques, which include a large series resistance, but by measuring the driver directly coupled to an amplifier, using the LinearX VIBox to measure both current and voltage separately and then using Ohm's Law to divide

DATA CHART

Brand . . . . . Infinity
Model 12DVQ
MSRP $444.95
Warranty . . . . . 3 years

MECHANICAL SPECIFICATIONS

Weight . . . . . 22 lbs.
Rear Mounting Clearance . . . . . 6.813"
Woofer Magnet Dim. (dia. X ht. In mm) . . . 178x22x2 (2 stacked magnets)
Voice Coil Diameter . . . . . 81.9mm (3.2")
Voice Coil Winding Layers . . . 4 (two 2 layer coils)

MEASURED T/S PARAMETERS

Nominal Impedance (ohms) 2
Revc (ohms) 1.79
(both 3.58-ohm voice coils connected in parallel)
Sd (cone area in sq. meters) 0.035

	LOW Q	MID Q	HIGH Q
Bl (motor strength in Tesla Meters)	11.70	9.53	7.81
Vas (in liters)	94.27	94.24	110.24
Cms (micrometers per Newton)	298.72	298.60	349.35
Mms (grams)	195.25	195.37	173.97
Fs (Hz)	20.84	20.84	20.42
Qms	6.30	6.58	6.52
Qes	0.33	0.50	0.66
Qts	0.32	0.47	0.60

POWER AND EXCURSION DATA

Sensitivity (2.83V/1M in dB)	92.2	90.41	89.66
Continuous Power Handling (watts RMS)	400	400	400
Peak Power Handling (watts)	1600	1600	1600
Xmax ([coil length – gap height]/2 in mm)	15.5	15.5	15.5

COMPUTER SIMULATION DATA

Enclosure size for simulation (cubic feet)
Sealed (Mid Q insert) . . . . 1.0 (50% fill material)
Vented (Low Q insert)1.75 tuned to 32Hz (15% fill)

-3dB (F3) at 2.83V
Sealed . . . . . (Qtc=0.89) 41.4Hz
Vented 34.8Hz

Voltage to achieve Xmax + 15%
Sealed 40V
Vented 43V

SPL at Xmax + 15% (17.8mm)
Sealed . . . . . 115.5dB anechoic
Vented . . . . . 117.5dB anechoic

SPL in-car measurement at 2.83 volts, 1 meter Peak reading non-weighted
40 Hz . . . . . 98.0 dB
80 Hz . . . . . 99.3 dB
Max SPL . . . . . 128.0 dB

voltage by current to get impedance. The biggest difference is how this is accomplished (see Web version for more information at www.caraudiomag.com).

Parameters shown in the Data Chart were used to produce computer simulations of two factory-recommended box volumes, one using the Mid Q insert and one using the Low Q insert. The sizes chosen from the factory selection were a 1.0-cubic-foot sealed box using the Mid Q insert and a 1.75-cubic-foot vented box using the Low Q insert and tuned to 32Hz with a 4-inch-diameter port.

Performance in the 1.0-cubic-foot sealed box produced a low-frequency rolloff of 41.4Hz with a box Qtc of 0.89. My preference would be to stuff this box a little more or make it somewhat larger to drop the small signal Qtc of the box down to about 0.7. This should translate to somewhat more accurate bass that will still sound good at very high volume levels. However, increasing the voltage input of the 1.0-cubic-foot sealed box computer simulation to 40V increases the excursion to its maximum linear level (about 17.8mm) and results in an output of 115.5dB. This is a reasonably impressive number considering the woofer is still operating more or less linearly at this point.

The vented box simulation had a lower F3 of 34.8Hz and a higher max linear SPL of 117.5dB. These numbers are based on sine wave analysis and the performance with program material will probably be at least 2-3dB greater before noticeable distortion. However, like most of the sophisticated subwoofers in this price range, they are easily capable of producing undistorted sound pressure levels high enough for you to want to own an SPL meter so you'll know exactly what SPL you are subjecting your ears to.

Along these lines, if you look at the LEAP 5.0 graphs you will see that something new is being displayed. Both graph sets, Fig. 1 for the sealed box and Fig. 2 for the vented box, have double sets of curves that represent the SPL in an anechoic chamber (red at 2.83V and black at max voltage) and a second set that represents the response in a car compartment (blue at 2.83V and green at max voltage). In this case, I used a 154-cubic-footer for the compartment size, about the size I calculated for my Eclipse GT. While the anechoic SPL maximums before severe distortion were 115.5dB sealed box and 117.5dB vented box, you can see that in a small car, these figures get much higher — a minimum of at least 7dB higher SPL! This number changes with the car volume and the peaks occur in different places, but that at least gives you some idea of the real world SPL when you are sitting in your car and cranking up the volume.

Infinity is offering a lot of trick technology with this subwoofer. The variable Q concept is definitely cool, and if nothing else inspires confidence in the high quality of engineering that Infinity is capable of. But, as usual, in the end, it all comes down to the subjective sound quality. So what's up with that? —V.D.

SUBJECTIVE

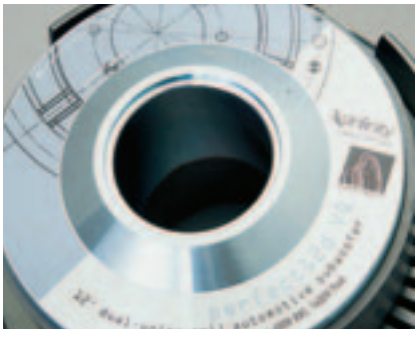
Well Vance, you are right about this subwoofer being crammed full of high technology. This awesome variable Q design is from someone who is really thinking outside of the box! And as you will read further along, it works.

SUBJECTIVE SCORE CHART

	Points Possible	Infinity 12d VQ
Overall Sound Quality	50	40
Tonal Balance	10	8
Low Frequency Extension	10	7
Clarity at Low Volume	10	8
Clarity at High Volume	10	8
Impact	10	9
TOTAL	**100**	**80**

To get the low down on this highly sophisticated subwoofer, I spoke to Andy Wehmeyer, Infinity's Product Marketing Manager Guru-Kinda-Guy. I asked Andy what enclosure type and size he recommended for the test, and I ended up with a half dozen boxes and alignments before I finally had to tell Andy that I was not going to test them all! In about 10 seconds he had given me a couple of sealed alignments, at least three ported and even a free-air design.

This just goes to illustrate the incredible versatility that Infinity has designed



MUSIC SELECTION

Artist & Title	Music Type	Points Possible	Infinity 12d VQ
Lenny Kravitz *Believe in Me*	Rock	10	7
Sade *Lovers Rock*	Smooth	10	6
10,000 Maniacs *Peace Train*	Folk Rock	10	6
Creed *Say I*	Rock	10	8
Harry Connick Jr. *We Are In Love*	Vocal Jazz	10	8
TOTAL		**50**	**35**

into this product. As Andy kept reminding me, "This is the first subwoofer that can be easily optimized for tiny sealed boxes, moderately sized sealed and vented and infinite-baffle applications." Once I got Andy back to earth, we settled on a sealed 0.7-ft3 enclosure for sound quality.

INSTALLATION

I had my guys at Speaker Works build a 0.7-ft3 enclosure, but as you will read later, I ended up building and using the 12d VQ in a 1.0-ft3 enclosure for all of the final listening. Once I got the Perfect 12d VQ into its enclosure, I headed out to my Ford F-350 Super-Duty truck. In the Ford, I found that the 12d VQ worked well in most locations, but it really kicked butt with the enclosure placed on the floor between the front and back seat, subwoofer facing up.

The 12d VQ is rated at 400WRMS for power handling and 1400 watts of music power. To power the subwoofer, I installed two Crossfire VR1000D amplifiers with a bridging module. Doing this will allow me to wire the 12d VQ's dual 4-ohm voice coils in parallel for a 2-ohm load. Two Crossfire VR1000D amplifiers wired with a bridging module at 2 ohms will deliver a throbbing 2000 watts of power! I used the internal crossovers from the amplifiers and bypassed the subsonic filters.

ADJUSTABLE Q — DOES IT DO ANYTHING?

The first thing I wanted to find out was if this adjustable Q thingy was just a bunch of marketing Barbara Streisand. For this section of the test I mounted the 12d VQ inverted so that the magnet was on the outside of the enclosure.

By changing these inserts, we are changing the amount of magnetic force (Bl) applied to the voice coil. The Low Q insert is the largest and it produces the highest Bl prod-

uct. Having a higher Bl product means you have more available force to move the cone, but it requires a more powerful counter force to help control the movement of the cone. By going to a smaller enclosure, we have a tighter or stiffer air spring that the woofer cone is working against. As the Q of a subwoofer goes up, the Bl factor drops and you need a larger and larger enclosure to soften the air spring. If you do not soften the air spring, the stiffer air spring will start to override the ability of the motor to properly control the movement of the cone, resulting in higher distortion and possibly damaging the sub. So as I am raising the Q of the 12d VQ, I will be expecting some pretty obvious changes in the sound quality because we will be moving radically away from the correct size enclosure.

I installed the Low Q magnet insert to begin. With this insert the 12d VQ should be optimized for the 0.7-ft3 enclosure that we are using. It sounds really tight and punchy, and hits hard.

I pulled the Low Q insert and installed the Mid Q one. The bass is now a bit looser. Not as tight, but the low frequency extension does appear to be slightly better. The power handling also has taken a step down. So now I go for the High Q setting by removing the insert altogether. First impressions were that the overall efficiency was now lower and that the bass impact response had radically changed. It was just out and out loose, with a lot of hangover. The power handling was way down and the woofer was just screaming that it was in the *wrong enclosure*, which of course it now was. Well, what do you know, this adjustable Q thing does work. Awesome! One subwoofer that can be tuned to match many different applications — I am getting excited.

OK, enough playing around, let's get to the listening! I reinserted the Low Q plug and mounted the 12d VQ in the enclosure the correct way. Then I cranked up Lenny Kravitz's album *Lenny*, track five, "Believe In Me." This track has a great opening bass line and a tightly recorded drum kit that will really exercise a subwoofer. At 80Hz the 12d VQ is loud and delivers chest-pounding impact. From 60Hz and below, the loudness level of the bass line falls off slightly. The 12d VQ definitely has a hump at about 80Hz and can tend to sound a little one note-ish. But the 12d VQ is not muddy like some of the other subwoofers that I have tested. I tried a number of tracks quickly and decided to try the 12d VQ in a larger enclosure, a 1.0-ft3 sealed.

The results were immediate. The upper bass hump is now much smoother and the low frequency extension is greatly improved with this slightly larger enclosure. The 12d VQ produced impressive impact and clarity. Imaging is good and mostly up front.

Next I listened to Sade's *Lovers Rock* album, the title track. This track has a bass line that moves from 80Hz to below 40Hz, and the upper frequency bass note hump is again noticeable, but not overpowering. A touch of equalizer, a slightly larger enclosure or possibly lowering the crossover frequency may correct the response curve. From 0:53 to 1:00, there is a declining scale of bass notes. The 12d VQ reproduces these note changes with authority and ease. It has excellent impact response and gave me a good shaking.

Next I put in 10,000 Maniacs' "Peace Train." The opening eight bars of this track have a deep 30Hz kick drum beat, one beat per bar. It's perfect for highlighting subwoofer impact and hangover, if there is any. The kick drum impact is very firm but it is missing the really deep fundamental note. Hangover is again minimal and the overall performance is great.

Next up is Creed's *Human Clay* album, track four, "Say I." After about 20 seconds, I found myself thinking that the 12d VQ is geared for rock music. The bass line came through super fast and tight. A lot of kids that I work with are asking for subwoofer systems that have "fast bass." Well, the Infinity 12d VQ has moved to the top of my list of recommendations.

I finished off with a listen to the title track off an old favorite album, Harry Connick Jr.'s *We Are In Love*. It features a fine recording of a closely mic'ed stand-up string bass. The bassist is getting a workout in this recording, going up and down the scale. The Infinity Perfect 12d VQ reproduces the attacks of the string plucks with great authority. I could feel them in my chest, and the note shifts are clearly defined and controlled.

CONCLUSION

Is this subwoofer the answer to all of your bass wants and needs due to its amazing versatility? It very well may be. It's a wonderful sounding sub with excellent detail and sound quality. It can be used in just about any type of enclosure, from a tiny sealed box to a moderately sized sealed or a vented, and even in an infinite-baffle application. All of that ability in one subwoofer? Impressive for sure. —E.H.

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