

## ARE THREE WAYS BETTER THAN TWO?

Using three speakers to divide the frequency range more suitably than two speakers is a fairly common practice in home audio. The basic idea is that having one speaker cover the lows, another cover the vocal range, and another cover the highs lets each speaker work in its ideal range. It also means that the crossovers can be out of the critical vocal range where phase differences can cause response errors and loss of stereo image.

This is all good in theory, but in practice a three-way system becomes extremely complex. The multiple overlapping frequency ranges altered by crossovers all mix together into a complex soup of lobes and phase and cancellations, not to mention diffraction and time delays. (Oh my!)

In the best situation, a three-way home system can be designed with all of the speakers in a fixed position in a cabinet and a reasonable guess at the listener's position. With this information, a good selection for individual speakers and a thorough understating of three-way crossover theory, you can design a system with reasonable results. (Check out Bullock's AES paper, "Passive Three Way All Pass Crossover Networks," for an idea of what that means — if you have a Masters in Electrical Engineering, that is.) Miss any of these elements and you are in for a pretty serious challenge. Throw the speakers into a car where you have no idea of the relative positions and have different time delays for the left and right channels and you have an engineering nightmare. Add to this the complexity of doing all of this "by ear" and you have the potential for disaster.

## THE SPEAKERS AND CROSSOVER

The speakers are obviously well made and are cosmetically equal to any of those of the high-end European manufacturers. This really is no surprise, considering that they are made in Sweden (DLS is based there). In fact, the speakers bear a striking resemblance to the Dynaudio parts.


The tweeter is a slightly oversized (28mm) silk dome, with a flat aluminum wire voice coil and neodymium magnet. The larger size allows for a low resonance frequency of 1200Hz. With a crossover frequency of 7000Hz, this means the tweeters' impedance rise at resonance should cause only minimal response errors. The tweeter is protected from fingers and errant elbows by a very attractive cage that looks a bit like Hannibal Lecter's mask. The tweeter kit is supplied with both angled-surface and flush-mount hardware (non-swiveling).

The midrange is also a dome style with a hand-doped fabric. The diaphragm is 52mm diameter and is recessed into a

# DLS UP-36

## 3-WAY COMPONENT SET

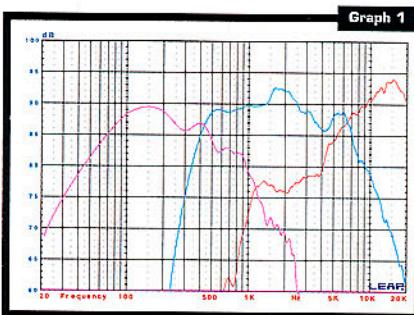
TEXT > REDROCK ACOUSTICS & ERIC HOLDAWAY :: PHOTOGRAPHY > STEVE SAWITZ

 YOU HAVE PROBABLY HEARD that speaker design is as much art as science. I have probably made that statement in these pages a few times myself. This means that there is also a wide spectrum of design philosophies that run the range from dry engineering based on tests and more tests to the other side, which is more listening-based and "tweaked." DLS is a company that falls into the latter camp. In fact, on its Web site, it states, "From the start we let our ears be the judge, as after all, they will be the only instrument assessing the performance of the speaker system in its final environment. Music is a

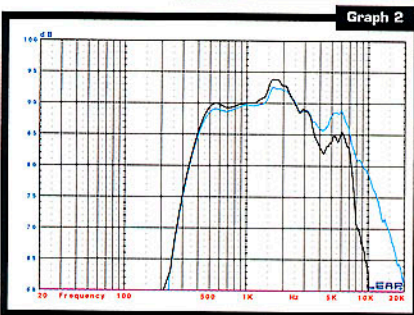
subjective science. Measuring instruments are useful to a point, but they can also impose limits. Our ears are needed to take the development further."

That philosophy shows through in the UP-36 three-way component set. As you will see, the overall response is not as smooth as other component sets that we have tested. In fact, some of the recommended settings create responses that are anything but flat. I am not sure if that makes these speakers sound any better or worse than "flat" speakers — Eric Holdaway will have to deal with that subject.

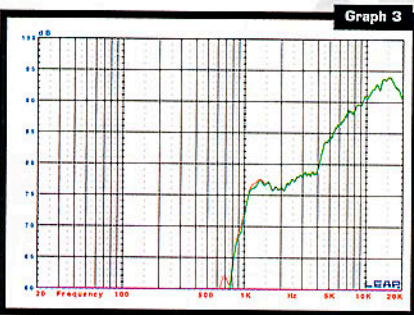
Graph 1



Graph 2



Graph 3



horn-loaded cup. This is also driven by a neodymium motor structure using a flat aluminum wire voice coil. The midrange has a resonance of 350Hz, which is really low for a 2" dome, so it can accommodate a crossover of 450Hz.

The 165mm (6.5") woofer is very unusual in appearance. It is one of the new breed of woofers using neodymium magnets. Typically you would need a 20-oz magnet to drive the 52mm (2-inch) voice coil on a woofer like this. The neodymium motor, actually called a "neodymium hybrid," is just barely 61mm (2.4-inch) diameter and 24mm (.94-inch) deep. This will certainly make installation much easier. The voice coil is also made with flat aluminum wire and has an Xmax of 3.5mm.

Just a side note: the flat aluminum wire is a pretty advanced piece of engineering. It provides extremely low mass coils and high gap energies. This translates to high efficiency and a relatively high speaker Q for better bass response. It is a clear indication of the engineering that went into these speakers.

The crossover is a little disappointing compared to the quality of the components. It does feature a huge "I" shaped steel core inductor for the woofer and mylar and polypropylene caps for the mid and tweeter respectively. However for a

system like this, I expected some sort of tweeter protection (this is car audio you know) and maybe a zoomier appearance. The tweeter and mid feature jumpers that switch between full on settings and an interesting attenuation — more later.

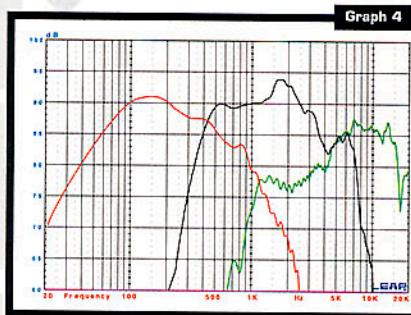
### THE TESTING

Knowing all of the potential hazards for three-way systems I was careful to make sure my set up was as controlled as possible. Speakers were mounted on an IEC baffle and tested at 1/2 meter both on and off axis. The testing was done on a DRA Lab MLSSA system using a lab quality amplifier and 100kHz microphone. Response below 200Hz was tested using the nearfield method and then spliced to the responses measured on the baffle.

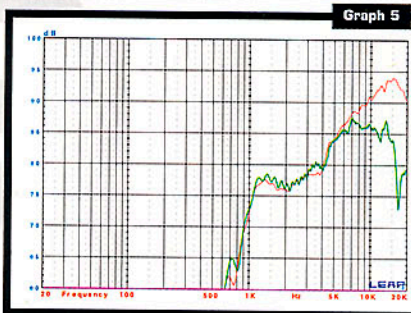
The first set of tests were of the components individually through the crossover. This gave a pretty good indication of the separate responses and how they might meld together in the combined response. Graph 1 shows the individual on-axis responses and Graph 2 shows the off-axis. These tests were all done with the levels set on the mid and tweeter to the "high" setting.

Comparing the two sets of curves it became apparent that there were substantial differences between the on- and off-axis responses for both the tweeter and the

Graph 4



Graph 5



Graph 6



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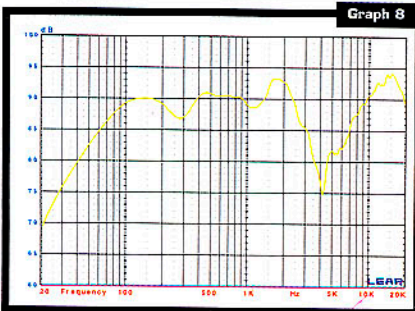
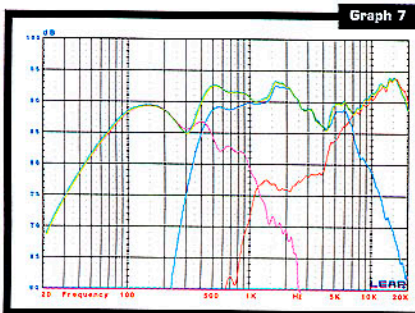
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midrange. This becomes even more clear in Graphs 3 and 4 showing overlays of the on- and off-axis responses. The midrange shows a pronounced reduction in output starting at 2kHz with a total reduction in the operation range at 5kHz of 6dB. This is still in the range before the tweeter kicks, so this doesn't bode well for the off-axis



testing. The tweeter has even worse problems. It has a huge drop in the off-axis high frequencies — 4dB at 10kHz, 10dB at 15kHz, and a huge cancellation hole at 17kHz. Even if you have some hearing loss at high frequencies, this means that there will be a dramatic difference between what you hear from your driver and passenger sides unless you can get both tweeters aimed at you at the same angle.

My next series of tests provided even more surprises. I used the switches to set the tweeter and mid to the "low" settings and compared the responses to the high settings. Graph 5 shows the on-axis response of the tweeters with high and low setting. There is virtually no difference in the responses. I checked the wiring to make sure I didn't make a mistake and then looked at the crossover design supplied with the kit. It shows that the switch provides an additional 3.3

#### OBJECTIVE SCORE (10 POINTS EACH, MAX)

|                   |   |
|-------------------|---|
| Sensitivity       | 8 |
| On-axis response  | 5 |
| Off-axis response | 3 |

ohms of resistance across the tweeter to the 15-ohm resistor already there. (The tweeter has a single capacitor in line for its crossover.) This is an unusual level control to say the least. There may be an audible difference but I am hard pressed to see it in the response.

The midrange jumper did make a difference in the response and unfortunately not a good one. Graph 6 shows the comparison of High and Low settings. The jumper doesn't cause a uniform level shift; it appears to change the slope of the high- and low-pass ranges. Looking at the crossover showed that the jumper added a 22-ohm resistor and 33μF capacitor across the midrange. Also very unusual design.

Keeping an open mind, I moved on to the system response. I started with the on-axis response with both mid and tweeter at the high settings, and everything con-

#### DATA CHART

|           |                                   |
|-----------|-----------------------------------|
| Brand     | .....DLS                          |
| Model     | .....UP-36                        |
| Web site: | .....www.dls-america.com          |
| MSRP      | .....\$675.00                     |
| Woofer    | .....DUP 6                        |
| Midrange  | .....UP 2.5                       |
| Tweeter   | .....UP1C                         |
| Crossover | .....Ultimate                     |
| Warranty  | .....Two Years (Dealer Installed) |

nected according to the wiring (no reversed polarity). Graph 7 shows this response and the overlaid individual responses of the separate speakers. There is a marked dip at 300Hz of 6dB and another pronounced valley between 2kHz and 15kHz of 8dB. These dips followed the individual curves and didn't appear to be phase errors (one of the drivers out of phase with the others).

The midrange appeared to be too pronounced in the overall response, so I used the jumper to set it to the low setting. Graph 8 shows the result. The 300Hz dip is reduced but there is now a huge dip at 4kHz of 20dB. This is an obvious phase cancellation and is caused by the addition of a crossover pole (the cap and resistor) making the crossover change from first order to a de-Q'd second order. Because the mid and woofer response was improved, I reversed the polarity of the tweeter. The results can be seen in Graph 9. This certainly improved the response over the in-phase setting but it's only marginally better than the response of the original on-axis test with tweeter and mid on high.

I moved on to off-axis testing, which is more like what the response will be in a

car. The first test was with the tweeter and mid on "high" and all polarity standard. Graph 10 shows the response and the individual responses overlaid. The marked high-level midrange response is even more pronounced with the reduced off-axis tweeter response. I again set the mid level to low and saw the same phase cancellations that I did in the on-axis response. Making the same changes, I got the response shown in Graph 11. Graph 12 shows a comparison of the on- and off-axis responses with correct drive phase. The responses are fairly similar except for the drop-offs caused by the reduced output at the top end of the mid and tweeter.

If you discount the notch at 17kHz for the off-axis response of the tweeter, both response are +/-5dB through their working range — if you make the phase change to the tweeter!

The final graph, number 13 (I promise), shows the impedance response of the system. Nothing too remarkable here. There is a dip down to 2.5 ohms at 2kHz but this should be handled by any high quality amp.

#### WOOFER PARAMETERS

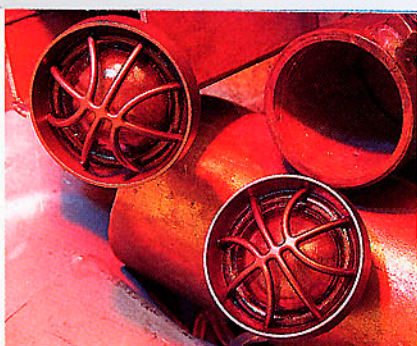
The woofers tested very closely to the specifications sent by the supplier. (Always a good sign.) The  $F_o$  is a little high at 73, but workable. The  $Q_{ts}$ , which in a door system is somewhat equivalent to a sealed box  $Q_{tc}$  or tuning, is .75. I like door speakers to have high  $Q_{ts}$  ratings. This means that they will have some decent bass and not sound anemic — .75 is right where it needs to be.

|           |             |
|-----------|-------------|
| $R_e$     | 3.4         |
| $F_o$     | 73.1        |
| $Q_{ts}$  | .75         |
| $Q_{es}$  | 1.1         |
| $Q_{ms}$  | 2.37        |
| $V_{as}$  | 9.05 liters |
| $BL$      | 3.97        |
| $X_{max}$ | 3.5 mm      |
| $M_{ms}$  | 11.09 grams |

#### SUMMARY

In the balance between art and engineering, I would like to think I am in the middle ground. In the balance between design by listening and design by testing, I am definitely on the testing side. This is especially true in the case of these articles where my directive is to test, not listen. That being the case, although these speakers look great and are of obviously high quality, there are pretty serious flaws that prevent them from being at the top of the heap in component sets. As I said in the beginning, three-way systems are innately hard to design. The speaker choices, in spite of their quality, may not be the ideal ones for a three-way system — it would have been nice to have speakers that had a better off-axis response. In my mind the biggest failure is in the crossover design. I'll say again that this is no easy task for a three-way; however if a bit more was spent on a higher order design or if it were at least optimized for smoother response (i.e. tested), they could have measured much better. The "low" set-



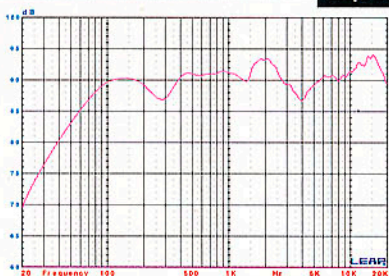


ting for the crossover still has me scratching my head. At the very least it is confusing for the user to have to change the phase if they want to reduce the speaker level. I can't wait to hear how the listening test went. Did these sound great in spite of the response problems? —P.T.

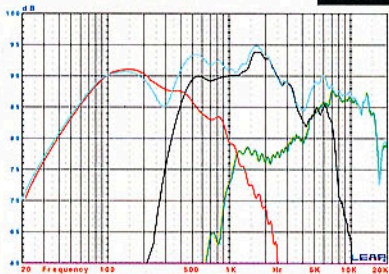
## LISTENING

Casey... So you're telling me that you gave AS&S managing editor Bob Hernandez the speakers that I am going to test and that they are in the trunk of his wife's brand new car? Great, so Bob's going to come by and drop them off? What do you mean, "Well no, not exactly?" His car just got impounded!?! You're kidding me, right? No, you're not... Bob really didn't think the cops would tow his car? You've gotta be kidding, he parked right under the sign that says, "No Parking Anytime." Great. Tell him, "That's why they call it DOPE!"

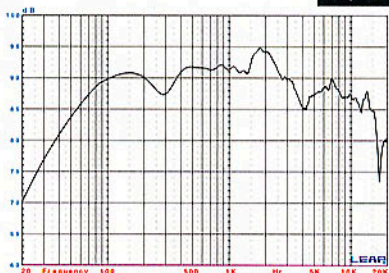
Graph 9



Graph 10



Graph 11





"OK, OK, I'll send Tuna out to help Bob recover his wife's car. What's that? Bob's wife is there too and she's a little unhappy about her brand new car getting towed? Yeah, I bet she's hot."

So I sent Tuna to go save the day and to get Bob's butt out of a crack. Silly me, I should have remembered the old saying, "No good deed goes unpunished." Did you know that police impound yards are not in the good parts of town and that they are guarded by very large and nasty looking dogs? (According to Tuna, Bob almost found the dogs the hard way, but that is a story for another time.)

Did you also know that police impound yards do not accept personal checks or credit cards? They are not the most trusting bunch. So the search for a working ATM was on! He needed \$200.00, cash only, thank you.

Several ATMs and about four hours later, the DLS UP-36 speaker system that Casey was telling me about finally showed up for me to test. Folks, welcome to my world.

The DLS UP-36's were none the worse for the time spent in police custody. They are packaged in a full color carton that is fairly compact for all of the equipment that is in it. The three-way crossovers are well built and compact too. After having to deal with the huge MB Quart 'Q' crossovers last time, these are a relief. Installation is very straightforward with these speakers, as they are all standard sizes and the woofer depth is reasonable, thanks to the radical neodymium magnets. Improvement in the area of documentation for setup and tuning would be helpful, however.

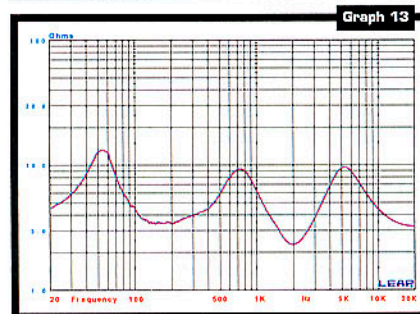
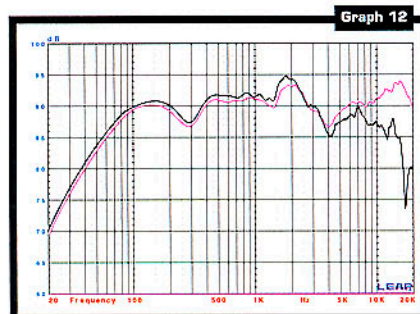
I decided to start with Tracy Chapman's *New Beginnings* album. I love the opening track, called "Heaven's Here On Earth." The opening eight bars set the mood with a beautifully recorded acoustic guitar, wood block, bass drum and tambourine.

The guitar has good tone and clarity. The wood block is nice but recessed and not as three-dimensional or woody-sounding as when I tested the Morel Supremo tweeters. The tambourine bangles are nice and smooth, but lacked some of the indi-

vidual-ness that I have come to expect with high quality tweeters. The UP-36's do not falter when the concert bass drum is struck. They do not have the bass extension of the much more expensive Quart Q's, but are excellent, delivering fast and punchy impact each time.

The vocal imaging is solid and fixed in its apparent location with correct height of the image. Tracy's voice is excellent in its detail and tone, but it is reproduced a little "dark," meaning a little lifeless. My best guess at this point is that the frequency response curve has a dip around 6kHz and that is the cause of the darkness. I ran this by Pat Turnmire of Redrock Acoustics and he suggested that I flip the polarity of the tweeter, even though I hadn't heard any strange lobing when I set them up. Sure enough, by reversing the polarity on the tweeters the vocal quality was greatly improved, restoring Traci's natural sound and improving high frequency detail. Much better in the upper voice harmonics.

*Weathered* is Creed's latest album, and "My Sacrifice" is the track that I am using. The guitar opening to this track comes across nicely detailed. The guitar string



#### SUBJECTIVE SCORE CHART

|                                     | Points Possible | DLS UP-36 |
|-------------------------------------|-----------------|-----------|
| Overall Sound Quality               | 20              | 16        |
| Tonal Balance (above 80Hz)          | 10              | 8         |
| Low Frequency Extension             | 10              | 6         |
| Clarity at Low Volume               | 10              | 9         |
| Clarity at High Volume              | 10              | 8         |
| Image stability                     | 10              | 9         |
| Listening fatigue (moderate volume) | 10              | 8         |
| Flexibility/Ease of installation    | 20              | 17        |
| <b>TOTAL POINTS</b>                 | <b>100</b>      | <b>81</b> |

sounds are excellently reproduced. Then the "wall of sound" hits you and there is an edge that's a little too aggressive for my taste. For me, this is a sign of a bump in the response curve around the 2kHz range (see Graph 12). The highs are good and detailed as is the bass reproduction, however.

Staying with male vocals, I moved to The Stock Brothers' excellent album *Called Out* ([www.stockbrothers.com](http://www.stockbrothers.com)). On the third track, "What Makes You Who You Are," the conga drums and percussion have good "skin," impact and detail. The acoustic guitar is well detailed and the

upper harmonics and string noises are splendid. The Stock Brothers' trademark three-part harmonies are reproduced in wonderful layers and depth with excellent image placement. The DLS UP-36's exhibit great imaging quality.

Going for the rap crowd, I switched to Eminem's *The Eminem Show* (specifically track five, "Square Dance"). The bass line comes through with impact and sharpness, but it is a bit light on the deep stuff. For a complete system, I would recommend a subwoofer to complement the DLS UP-36. Em's vocal tracks are clear and loud. The UP-36's do not leave out any of the musical content.

Next I played Sade's *Lovers Rock* album, specifically the title track. The cymbals and high hat details are good and clear, but could use a little more shimmer. Sade's vocals sound natural, with just the right amount of nasal-ness that I expect when listening to Sade. The imaging is centered and non-moving. Imaging is definitely a strong point with the DLS UP-36's.

The bass line on this track moves from 80Hz to below 40Hz repeatedly and the UP-36's do a good job here. As stated above, combined with a subwoofer these speakers will be ready for competition.

I enjoyed listening to the DLS UP-36 and at \$675, this component set is an excellent value. The speakers image very well and excel in their detailed reproduction of sound. Installation ease is good, helped by the fact that the crossover, while being a three-way, is still fairly compact. I do recommend that DLS upgrade its user's manual and installation instructions to improve the understanding of all of the great features these speakers offer.

—E.H.✖



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