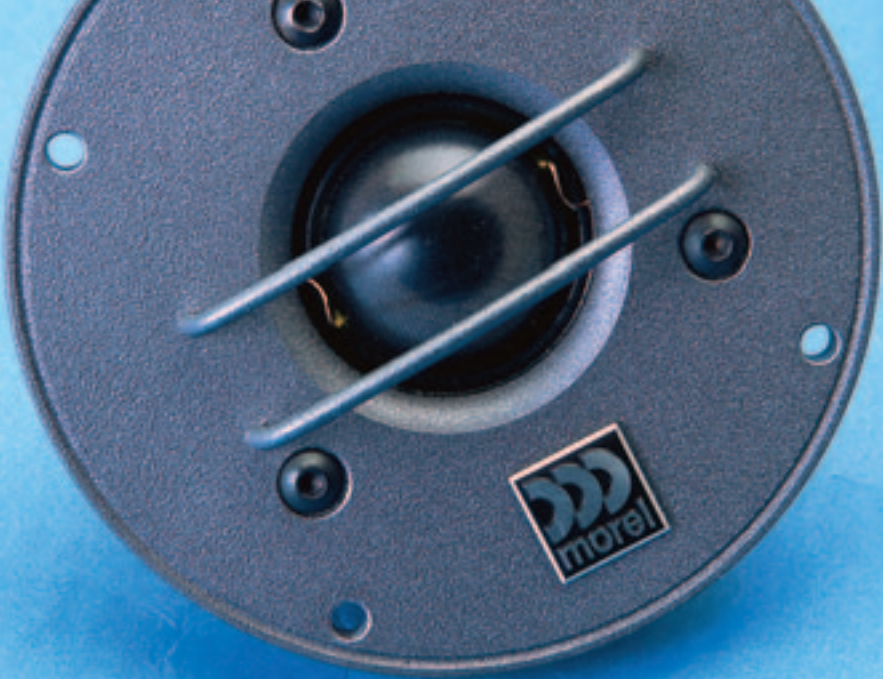


car audio

THE AUTHORITATIVE ELECTRONIC SOURCE

AND ELECTRONICS



TEST REPORT

Morel is one of a very short list of speaker manufacturers that has devoted the time and resources to the art of tweeter design and manufacturing. In fact they have become well known in the rarefied domain of exotic high-end home audio speakers for building some of the world's best tweeters.

Morel is also unusual because they are located in Israel. In fact they are the only loudspeaker manufacturer in that country. They were founded by Meir Mordechai, who was born to a family of musicians and wanted nothing else in life except to build the best speakers in the world. Under his leadership, Morel has advanced an impressive range of speaker technologies. They were one of the first companies to use neodymium magnets, aluminum voice coil wire, optimized wire shape (hexagonal), external voice coil technology, ultra large voice coils on midbass speakers, and many other technologies.

So when Morel announces a new tweeter designed to dramatically improve the state of art in car audio, and they name it the "Supremo" — it's time for audiophiles and enthusiasts everywhere to take note.

The Technology

When you are one of the leading speaker manufacturers in the world and decide to design a car audio tweeter from scratch

with a "money-is-no-object" attitude, you start by identifying the special problems unique to car audio. You then apply your experience and technology to the problem areas and maybe even invent some new technology along the way. Here are a couple of examples:

■ Problem 1: Speakers are rarely listened to off-axis.

Most car audio tweeters don't even try to address this point. Often times they are copies of rather successful home tweeters designs and typically have a low profile dome shape that has nice flat on-axis response, but are terrible off-axis.

Morel's solution: build a dome with as close to a half sphere shape as possible to maximize the off-axis response, and solve the problems inherent in using this shape

MOREL SUPREMO

MOBILE WIDE RANGE TWEETER

BY ► REDROCK ACOUSTICS & ERIC HOLDAWAY ■ PHOTOGRAPHY ► STEVE SAWITZ



CAR AUDIO TWEETERS ARE A PRETTY MIXED BAG.

Virtually every type and quality level exists; cheap paper cones, mylar semi-domes, standard domes made from every material imaginable, ribbons, piezo, even tweeters that only look like tweeters but are actually just domes glued to a piece of plastic to make a 2-way coax look like a 3-way. As a general rule, though, the sound quality is secondary to the cosmetics or mounting method, and as Asian-built tweeters become more and more the norm, the sound quality drops even further in the balance. The reason for the range of tweeter types and general lack of high quality tweeters in car audio, is that it is easy to build a tweeter, but it is extremely difficult to build a good one.



PARAMETERS		Supremo
Fs	Hz	819.2
Re	Ohms(dc)	5.25
Qms		1.2
Qes		.656
Qts		.424
SPLref	dB(2.83V)	92.5

in many ways, unlike anything that has come before.

Supremo Features

- **1 1/8" voice coil** for a larger radiating surface and lower resonance.
- **Underhung gap geometry** for higher linear excursions and lower distortion.
- **Symmetrically balanced neodymium motor** for highest magnet field energy.

- **Aluminum Hexatech voice coil** optimizes the translation from electromagnetic energy to mechanical energy.
- **Short, large diameter vent hole** prevents reflections from the back side of the dome. (This is a common problem with virtually every dome tweeter causing a nasty spike or dip in the response.)
- **Tuned back cup** allows a low, controlled resonance for lower crossover frequencies. (2200 at 6 dB/octave!)

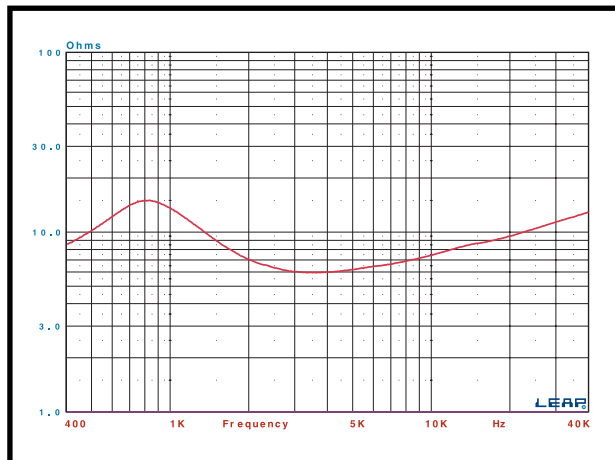
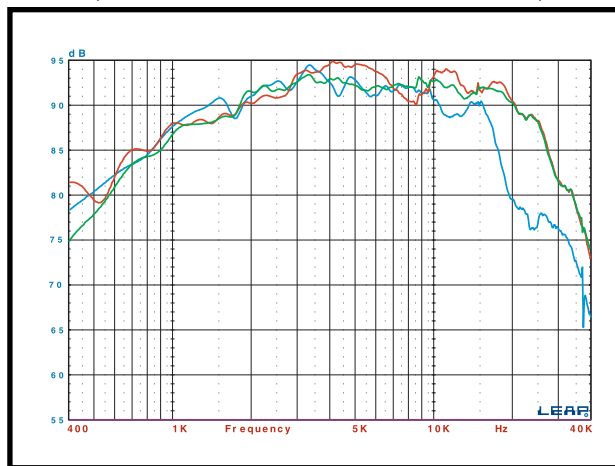
(terrible on-axis response, high distortion, low efficiency, just to name a few).

■ **Problem 2: High resonance tweeters don't work well with car audio woofer/mids.**

Car audio woofer/mids suffer from the same location issues as tweeters, this means that the upper midrange suffers off-axis as the sound begins to beam. A typical 6.5" speaker starts becoming directional at about 2200Hz. This means that if you are listening to it 30 degrees off-axis, you may not get much response above 1800Hz (even on the best speakers).

Morel's solution: design a tweeter with a very low resonance so the crossover point between woofer/mid and tweeter can be dropped below the point where the woofer's response has dropped off. (Most dome tweeters need to be crossed over around 4 kHz)

If you carry this process on long enough, you begin to define a product that is uniquely optimized for car audio and,

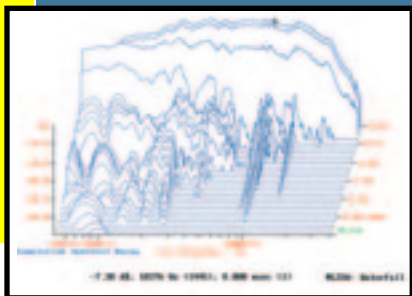
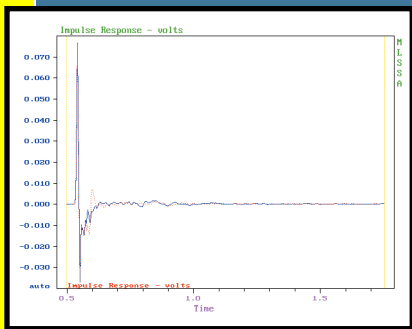


- **Optimized dome material and coating** for smoother response on- and off-axis.
- **Van Den Hul Silver-plated linear crystal input cables.** Eliminates the losses in push-on terminals provides an absolutely no-compromise connection. (Now if we could only afford to run this stuff from our amps...)
- **Documented matched pairs.** Each speaker set comes with a real birth certificate response curve and the speakers are carefully matched. (The curve match my tests exactly!)

Testing

The testing was done on a MLSSA system using ACO pacific 100 kHz. Mics., a class A lab amplifier, and ultra high grade cables. The speakers were mounted in an EIC baffle accurate to 200Hz. with a microphone position of .5 meter and an input voltage of 2.83 volts. The 0.5 meter response was normalized to one meter. All of the response graphs were exported to LEAP to make their graphic output higher quality.

To begin my frequency



response testing, I mounted the tweeter onto a test baffle — more clearly, I mounted the back flange of the tweeter on the surface of the baffle with the magnet passing through a hole in the middle of the baffle. This meant that the front of the flange was a 1/4" higher than the face of the baffle. When I took my first measurement, I found that the response curve was very different than the curve that Morel sent along with the tweeter. This isn't unusual to see from most manufacturers, but from Morel it surprised me. I suspected that diffraction might be the cause so I made an adapter panel that was even with the front surface of the tweeter and re-tested. Now the response was very flat and exactly like the Morel birth-certificate. The diffraction caused an error in the response curve of 4dB! This is certainly audible, and anyone using this tweeter should take the time to fit it flush to the mounting surface. You can see the variance between the surface mount and flush mount response in figure 1. In the impulse response (figure 2) you can easily see the spike caused by the diffraction just after the initial arrival. (The surface mounted tweeter is the dotted red line)

The flush on-axis response was pretty amazing, +/- 1.5 dB from 2kHz to 20 kHz – with a sensitivity of 93dB at 2.83 volts! This is hands down, the smoothest dome tweeter response built for car audio I have tested (or seen). This is very surprising considering the shape of the dome. Typically, with a dome this tall, major peaks and/or dips appear between 10-20kHz. The Supremo stayed flat throughout that range. It also fell off above 20kHz smoothly, a good sign that that dome material is well

damped and all of the parts are working well together. This is no small feat when a simple change in glue properties can cause response errors in the range of 4-5 dB.

The 30 degree off-axis test was also quite good. The response stayed flat until it hit 10kHz and then had a minor dip and rise to 15kHz, where it started its final roll-off. This is again the best off-axis dome response I have tested and even more remarkable because it is a oversized dome.

I was curious to see a waterfall curve for the tweeter, to see if there were any resonances that might not be as visible in the initial response curve. Waterfall responses are basically frequency response curves that are taken in separate time slices. Ideally a waterfall response will have the form of the initial response curve as a plateau at the back of the plot, and then fall quickly like the edge of a cliff to a flat plain. Errors will show up as undulating ridges



starting from a dip or peak in the initial response and continuing through the plane to the front of the graph. Errors can be caused by material resonances, standing waves between the diaphragm and magnet assembly, and many other issues. The Supremo was again, pretty much perfect. Two very low energy bands at 10kHz and 14kHz were visible, but compared to the Grand Canyon topography of most tweeter's waterfalls, the Supremo looked like a flat desert.

The impedance curve held no surprises, peaking at 15 ohms at the resonant frequency of 819, and falling to a valley of 5 ohms at 2500. The relatively low Q peak at

resonance (.424) will make a very smooth crossover transition.

The final series of tests that I made were single frequency distortion at incremented voltage levels. I used the recommended 2nd order crossover at 2200Hz and tested at 3kHz and sweeps from 3 to 10kHz. I stepped the testing voltage from 2 volts to 34 volts RMS (220 watts) and tested total harmonic distortion and the even/odd contributions. This of course is only an approximation of how much power the speaker might take before you could hear audible distortion, but it is also a quick way to see how a speaker reacts to stress. Most 1" dome tweeters will create high levels of distortion at some point in this test and usually well before 100 watts. The Supremo showed consistently low levels of distortion in the range of 0.64% total, 0.04% even, and 0.635% odd up to 34 volts. At that point my test amplifier hit its limits. Morel claims 220 watts with a 12dB/octave crossover at 2200Hz and 120 watts with a 6dB. These are pretty conservative based on my tests.

So now to my final testing results. Without question, these are the best car audio tweeters I have tested. I will leave the listening tests and installation tips to Eric, but the Supremo lives up to its name and is a perfect 10 across the board. —RR

Subjective

Tweeter test... Hmm... A tweeter test? Hello, Casey, are you there? You're cell phone must be breaking up again; I thought I heard you say that you want me to listen to tweeters. Ok, ok Casey. When will I ever learn not to use the "He's out of his mind" tone when I question what he has told me! Well, this should be different. And it is!

So the tech editor shows up with the Morel Supremo tweeters (No we are not making up the model name, honest!) The packaging is nice. The outer sleeve of the box has great looking graphics and proclaims that the contents are a "Matched Pair." The box itself is corrugated on the outside with a smooth black finish that looks real "rich," as in expensive. The data sheet gives you all the information that you could possibly want to know about the tweeters. Included in the documentation is a frequency response graph for the pair of "matched" tweeters. The graphs lay over one another to perfection. They really are "matched." Very nice indeed. Another nice touch is the inclusion of the unit serial numbers on the graphs, as well as the specification of how the frequency response measurement was done.

I open up the boxes and find that the Supremo tweeters are what I call, large for-

OBJECTIVE SCORE CHART

	Points Possible	Morel Supremo
Sensitivity	10	10
On axis response	10	10
Off axis response	10	10
Total Points	30	30

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mat tweeters. More like a home audio tweeter in size and shape. This is how all tweeters used to be built. Not the mambi-pambi micro speck tweeters of today. No way! A 4" diameter mounting ring, and a 28 millimeter, "Acuflex" coated textile soft dome with an underhung voice coil. I'm getting excited just looking at them. Hey, I'm a sucker for large format tweeters. Especially ones that have rear enclosures, which the Supremo's do!

Most dome tweeters will have a foam plug or a felt pad fit to the top of the pole piece inside the dome to help absorb and break up the rear sound wave. That can be problematic and ineffective. If the rear sound wave is not controlled properly or attenuated enough by the insert, the rear sound waves will reflect back out the front of the diaphragm. This reflected sound will cause both destructive and constructive interaction with the front waveform, creating comb filtering. This interaction will result in poor frequency response and higher distortion. The Supremo attacks this problem by using a vented pole piece behind the diaphragm. The rear sound waves travel down the pole piece vent and into an enclosure that is behind the magnet. The rear sound waves are largely absorbed by the materials inside the rear enclosure and do not reflect back out the front of the diaphragm. Thereby lowering distortion and improving the frequency response.

Morel is so confident in this product, Nir Paz, Morel's North American Marketing Manager, invited me to hook them up directly to my amplifier, no crossover. Now, I would normally be afraid to do so, because the results are usually catastrophic failure of the tweeter. But, I have done this test on another tweeter that is very similar in design, and was shocked at how well it handled the power and low frequency info. *Do not do this at home* though; after all, I am a trained professional.

The Supremo's retail for [REDACTED] a pair. That is expensive, but they also have a lot of technology. From their very good looks, to their Van Den Hul silver-plated hook-up leads and the pair of parallel bars that act as a grill for the dome, the Supremo's are class.

For a crossover, I settled on a 2nd order, 2-way passive crossover with a center frequency of 2kHz. I set the crossover up with three different tweeter output levels and ended up using the -3dB output. This level of attenuation best



matched the output level of the Morel HCW-6.5 woofer that I was pairing the Supremo tweeter to.

I jumped into a jazz piece by Chick Corea, *Bissau's Blues*. This track opens with a closely mic'd piano and drum kit. The Supremo gave a great sense of the piano size and clarity. I even got a wonderful sense of the size of the room. The piano was very realistic. The stick taps on the cymbals were not as "woody" as on my reference system and they could use a little more shimmer.

On Tracy Chapman's album, *New Beginnings*, the first track, "Heaven's Here On Earth", opens with a simple wood block,

SUBJECTIVE SCORE CHART

	Points Possible	Morel Supremo
Overall Sound Quality	20	16
Tonal Balance (above 80Hz)	10	9
Low Frequency Extension	10	9
Clarity at Low Volume	10	8
Clarity at High Volume	10	8
Image stability	10	8
Listening fatigue (moderate volume)	10	9
Flexibility/Ease of installation	20	13
Total Points	100	80

tambourine, and acoustic guitar. The wood block strikes have excellent detail, realism, and a fixed - non-moving image. The tambourine images well, but I do not get the full detail of each of the bangles shaking independent-

ly. The guitar is nice and well rounded, but a little boxed. There should be a little more air. Vocal reproduction is nice with a little more sibilance than I would have expected from Chapman.

Next, I tested with a male vocal track, from Chris Isaac's *Heart Shaped World* album. On the 5th track, "Wicked Games", the rhythm cymbals are open sounding with a nice ring. The brush strikes on the snare have excellent detail. The male vocals are great with good clarity and thickness. The Supremo is really well balanced overall and enjoyable.

I slapped in a classical disc next, Telarc's 20-bit recording of Schubert's *Symphony #9, The Great*. Wow! This is really relaxing and enveloping. Imaging is layered and wonderful. The hall is large and alive with ambience. The sound is soothing, and warm. It's almost like being there. Definitely, one of the best reproductions of classical music I have tested.

The Morel Supremo tweeters are high-tech marvels. They sound great and will out perform many tweeters that are available. I do wish, however, that they came with a crossover and matching woofer. This tweeter would have racked up a much higher score in the "Ease of Installation" category if they were available that way. As it is, they have achieved the highest score that I have assigned so far.

If you are serious music lover, you should get these tweeters. Thankfully, no funky chrome to polish like on some speakers. Morel put their money into research that improved the sound quality and performance. So, yes, these tweeters are expensive, but it is money well spent to achieve a high level of sound. —E.H.✽

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