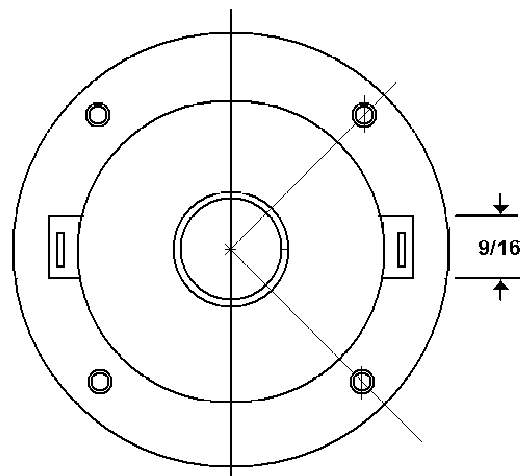
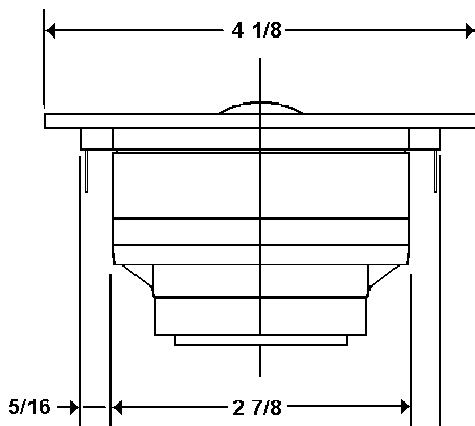


# North D28-06S

*High output, high performance silk dome tweeter*

## FEATURES:

- 28 mm Hand-Coated Silk Dome
- Middle-Hung Geometry
- Extended Pole
- Faraday Sleeve
- 1.0mm p-p excursion
- Massive Stacked Magnet Motor
- MAPD-loaded rear chamber
- Reinforced Back Cup
- Low Resonance
- High Excursion
- Very High Sensitivity
- Tinsel Voice Coil Leads
- Light Magnetic-Fluid Cooling
- Replaceable Butterfly Assembly
- Heavy Duty Gold-Plated Connectors
- Machined Aluminium Face Plate
- Recessed Mounting Screws
- Magnetically Shielded
- Broken In and Individually Tested
- Provided in Match Pairs
- MSRP \$229 per matched pair
- **Sale \$139 per Matched Pair**



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## **DESIGN GOALS and SPECIFICATIONS:**

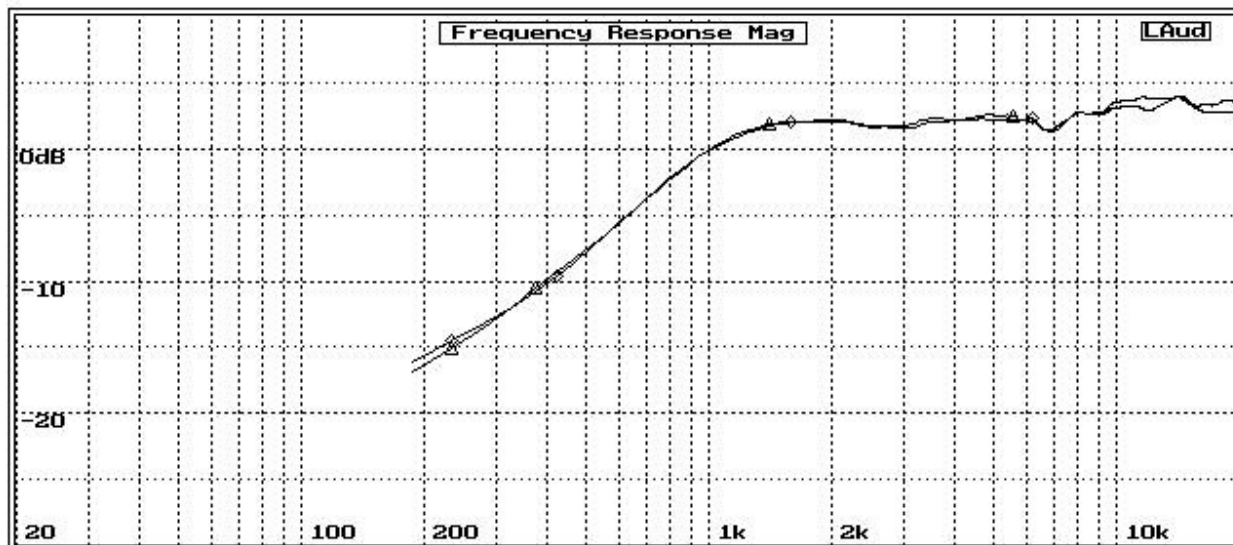
- Excellent Listenability
- Smooth, gently rising response to 20kHz
- Standard 104-mm Faceplate
- Magnetic fluid for cooling only
- Nominal Impedance: 6 Ohm
- DC Resistance: 3.6 Ohm
- Impedance resonance peak below 10  $\Omega$
- Stable Impedance above 1.5kHz
- Bandwidth: 1600 Hz-20kHz
- Sensitivity: 92.0dB @ 2.83V, 1m
- Voice Coil Diameter: 28mm
- Voice Coil Height: 1.8mm
- Air Gap Height: 2.8mm
- Linear Excursion: 1.0 mm
- Resonance Frequency: 800 Hz
- Frequency Response  $\pm 0.5$ dB



## **DESIGNER'S NOTES:**

This tweeter was conceived of as a silk dome destined for very best high efficiency, very high performance applications.

Silk is the preferred diaphragm material as it is readily available, extremely resilient, easily coated, bonds well to voice coil assembly, and has a unique sonic "character" that this designer prefers. A silk dome will have well controlled output up to 20kHz and, properly treated, will not exhibit sibilant emphasis, brittleness or sharpness.



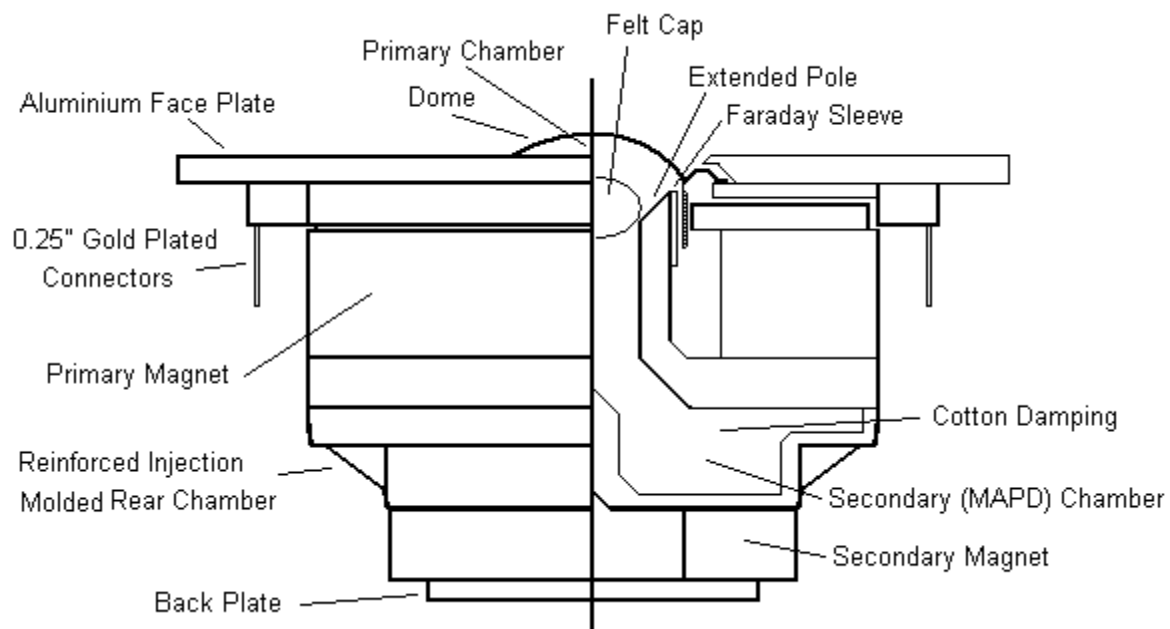
Anechoic 2pi Frequency Response Curves on axis and 5 degrees off axis

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28mm was chosen as the voice coil diameter because this tweeter is designed specifically for applications where the crossover frequency is near 1.5kHz (defined as the -6dB point of the electrical transfer function) and the electrical crossover slope is 12dB/octave or greater. The 28mm diameter allows for a larger motor assembly with a large radiating area, therefore a lower fundamental resonance and increased sensitivity.

Employing the "Middle Hung" geometry, with a short top plate and extended pole piece, allows for the lowest distortion under all excursion conditions throughout the lower treble. Up to its mechanical limit, the dome voice coil sees a symmetric flux distribution. Because the voice coil is longer than the top plate height, the fringe flux becomes part of the BI product. This also increased sensitivity by 0.1dB.



North D28-06S Exploded View

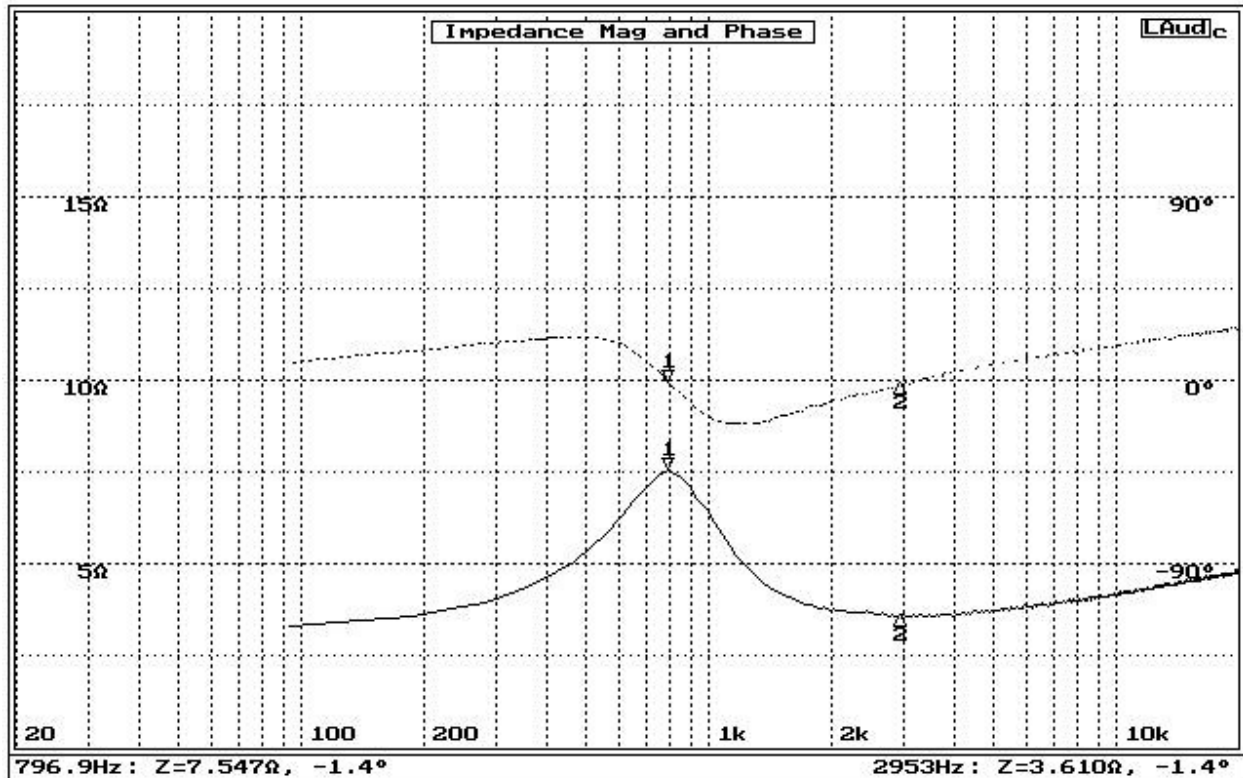
At high frequencies, the wool felt plug immediately behind the dome is a transmission line absorber. At lower frequencies (below 3kHz), the wool felt becomes semi-permeable and acts as the aperiodic couple to the cotton-filled MAPD rear chamber. The MAPD technique in this application lowers the tweeter impedance at its fundamental resonance to below 8 Ohms, without employing high-viscosity magnetic fluid. This allows for a very low viscosity magnetic fluid to be placed in the gap, functioning only as a thermal conductor as no additional mechanical damping is required.

Encasing the extended pole with a copper Faraday Sleeve that extends well above and below the voice coil excursion limits lowers harmonic and intermodulation distortion in the upper treble by 20dB compared with conventional motor designs. The excellent thermal conductivity of the copper also further increases voice coil thermal capacity.

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The Faraday Sleeve also reduces voice coil self-inductance, so the crossover load is nearly flat from 1.5kHz to 20kHz, minimizing the circuitry required and simplifying crossover design. In this case, the impedance is 4.25 Ohms  $\pm$  0.75 Ohms from 1.5kHz to 20kHz with no Zobel, a more stable load than can be achieved by most conventional tweeters with a Zobel or other impedance compensation circuitry.



North D28-06S input impedance

Employing a double-magnet motor with an additional back plate increased the driver output by 0.25dB. This system also improves the mechanical performance of the injection molded back cup, and provides nearly complete magnetic shielding.

Tailoring the frequency response for a smooth, 0.5dB rise from 2.5kHz to 20kHz and a very slight dip at 2kHz was done to simplify crossover design. The reason this is so important is that cabinet edge diffraction effects will *always* create a hump in the tweeter frequency response near 2kHz. One can partially compensate for this with the crossover network, but this often results in a low-Q crossover which begins roll off well above 2kHz. By adding a gentle rise above 2kHz, the designer is allowed to employ a high pass filter with a slightly firmer Q (0.5 to 0.7) to get flat frequency response throughout the entire pass band. Three more detailed discussions of the need for frequency response contouring can be found on the [North D25-06S](#) Link, James Moriyasu's article "Acoustic Diffraction: Does it Matter?" in Voice Coil Magazine 02/03, and Mithat Konar's article "Diffraction Insights" from AudioXPress 07/02.

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## **FINISHING TOUCHES**

Other than excellent impedance and frequency response characteristics, we added the following details....

- 1) The face plate is machined aluminium with a gorgeous automotive-grade silver metal flake finish. Face plate dimensions are exactly the same size as the Scan Speak D2905/9500 and North D25-06S, so we would not have to re-tool the North Creek Music cabinets for this tweeter; all North Creek cabinets will accept any of these tweeters.
- 2) Terminals are 1/4", heavy-duty gold-plated brass and accept 1/4" quick connects.
- 3) The mounting screw positions are recessed to accept a standard #6 driver screw.
- 4) Voice coil butterfly assembly is field replaceable.
- 5) We provide the tweeters in matched pairs or quads, broken in and with curves, at no additional charge.



## **SUBJECTIVE SOUND QUALITY**

In this day and age, when we have gone to the Aurum Cantus G1 ribbon as our ultimate reference tweeter, it was an interesting exercise to see how good we could make a high sensitivity soft dome. The three key ingredients of the North D28-06S are: 1) the stacked magnet motor; 2) correct frequency response contouring; 3) the Faraday sleeve.

The stacked magnet motor gave us that extra tiny bit of output – up to 92dB from 91.75dB. Not a lot but for a tweeter that will undoubtedly find many homes with SET amplification, every little bit is important. Adding the black powder-coated steel back plate creates a partial magnetic shield that is satisfactory for most Audio-Video applications.

Frequency response contouring – with the little dip at 2kHz and the smooth rise to 20kHz – greatly simplifies not only the crossover design process but also the resulting topology. The North D28-06S requires only a textbook second order filter to sound its best. Likewise, because crossover component count is reduced, the designer is at liberty to use higher quality capacitors and inductors in the network.

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The Faraday Sleeve – this technology is actually borrowed from the North Leviathan subwoofer driver, which has a Faraday sleeve along the entire 4" height of its underhung gap. The Faraday sleeve improves voice coil cooling, minimizing the need for magnetic fluid. It also reduces voice coil inductance, eliminating the need for a Zobel or other impedance compensation network. Finally, it reduces harmonic and intermodulation distortion by 20dB – or an entire order of magnitude - compared to conventional tweeters.

So how does it sound? The North D28-06S is exceptional. Lightweight, detailed, dynamic, naturally musical. It can also play extremely loud without a hint of fatigue or overload.

Compared to the Scan-Speak 2905/9500, the North D28 is not quite as velvety on the top end, but it is equally smooth and with a nice sparkle that many listeners will prefer and those with tube equipment demand. In terms of speed, clarity and overall resolution, the North D28 is a considerable step up.

The Scan Speak D2905/9900 Revelator is very slightly better in overall resolution, but in both the lower treble (where due to its absence of magnetic fluid the Revelator requires considerable crossover expertise to get the most out of it) and the extreme upper treble, the North D28-06S has the edge.

In this regard, the North D28-06S is most like a Scan-Speak D2905/9700 Aries (a Revelator motor and 9500 face plate), but with nearly 3dB more output.

For those searching for a high efficiency silk dome offering the very best in dynamics, detail, smoothness, clarity and most importantly natural musicality at an affordable price, the North D28-06S has no equal.



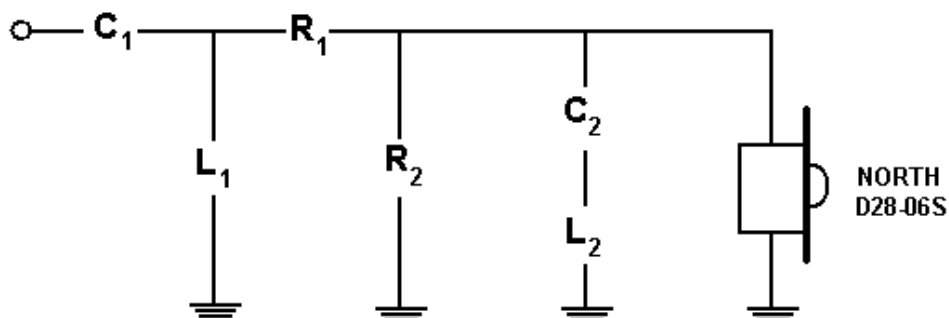
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## SUGGESTED CROSSOVER TOPOLOGY

The North D28 works best with a minimalist crossover topology and sounds it best when crossed around 2kHz. The suggested topology is:



NORTH D28-6S SUGGESTED CROSSOVER TOPOLOGY

where the product of  $C_1$  and  $L_1$  is around  $3.5 \times 10^{-9}$  (i.e. 11.1uF, 0.325mH or 7.1uF and 0.47mH) and  $R_1$  and  $R_2$  are the attenuation resistors.

$C_2$  and  $L_2$  form a trap that acts as an electrodynamic brake at the tweeter fundamental resonance, which is required if  $R_2$  is greater than 10.00 Ohms or the  $C_1L_1$  product is greater than  $3.5 \times 10^{-9}$ .  $C_2 = 30\mu\text{F}$  and  $L_2 = 1.25\text{mH}$ , 24 AWG (with around 1.5 Ohm DC resistance).

Because so few components are required, it is strongly suggested that one use only those of the highest quality. We generally make the 11uF out of a cascade bypass 10uF Zen + 1uF + 0.1uF, all Crescendo, and  $L_1$  with 12 or 10 AWG.

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## Comments:

Hello my name is Jamie P., I'm a design student at Northern Michigan University. A few months back I purchased a set of your NorthD28 tweeters for my final graduation project. I'm am super pleased with the tweeter's, they are the best dome's I've ever heard! They are so smooth and never get harsh at any volume level or frequency. I've sent a few pictures along to show you the final product. The design is a simple two way system supported by the Adire 6.8 mid/bass "nice sounding driver" the cabinets are 1.5" MDF with a hand made fiberglass mold. In the near future I plan on starting my own speaker line with hand built cabinets and USA built drivers. So I hope to do more business with your outstanding products in the future. Thank you Jamie P.



George,  
Just received your D28 tweeters and for kicks I just threw them in my present speakers without any changes to the covers. Wow! I can't believe how smooth they are. Can't wait to build the crossovers but I don't want to shut down my receiver, I am enjoying the music that much.  
Thanks again,  
Arunas S.