

# Sound Through Glass

*Glass diaphragm technology and the 202N-GL — the world's only compression driver with a glass dome*

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## Executive Summary

High-frequency reproduction in professional loudspeakers has always been limited by one component: the diaphragm of the compression driver. The ideal diaphragm would be perfectly rigid, vanishingly light, and able to absorb its own resonances. No conventional material offers all three properties at once. Titanium and aluminium are stiff but ring; polymers are well damped but soft; beryllium approaches the ideal but is hazardous to process and expensive.

This paper presents a fourth path: amorphous, chemically strengthened glass, precision-formed into a dome. Glass transmits sound faster than titanium, is almost half as dense, and dissipates internal vibration roughly 7.5 times faster than either titanium or aluminium [1]. It behaves like a metal where stiffness matters and like a soft dome where damping matters.

REDCATT has applied this material to the 202N-GL, to our knowledge the only compression driver in the world built around a glass diaphragm. The diaphragm is entirely REDCATT's own development — the glass composition, the forming process, and the assembly technology, all engineered in-house over years of development and currently patent pending. Klippel measurements confirm the theory in practice: a smooth response from approximately 1 kHz

to 20 kHz at 109.5 dB sensitivity, free of the breakup signature that characterizes metallic domes.

## 1. Why the Diaphragm Decides the Sound

A compression driver is conceptually simple: a dome diaphragm driven by a voice coil compresses air through a phase plug into a horn. Below a certain frequency the dome moves as a rigid piston, and its output follows the electrical signal faithfully. Above that frequency the dome begins to flex — it breaks up into regions vibrating out of phase with each other. Breakup adds resonant peaks, response ripple, and harmonic distortion exactly where the ear is most sensitive.

Two material properties govern this behavior. The speed of sound in the material, approximately  $\sqrt{E/\rho}$  where  $E$  is stiffness and  $\rho$  density, determines how high in frequency piston motion holds — faster is better. The internal damping factor ( $\eta$ ) determines what happens when breakup eventually occurs: a poorly damped material rings like a bell at its breakup frequency, while a well damped one dissipates the resonance as heat. Density matters too, since a lighter dome means less moving mass and higher sensitivity. Diaphragm selection is the art of balancing all three [2].

## 2. The Materials Engineers Have Had to Choose From

Material	Density (g/cm <sup>3</sup> )	Young's modulus (GPa)	Sound velocity (m/s)	Damping factor ( $\eta$ )
Beryllium	1.85	287	12,500	0.005
Glass (chem. strengthened)	2.4	70–80	5,800	0.015
Aluminium	2.7	70	5,400	0.002
Titanium	4.5	110–116	5,200	0.002
Paper	~1.0	1.9	3,200	0.040

*Sound velocity and damping factor as published by Nippon Electric Glass [1]; modulus and density ranges per BDNC [2].*

Titanium has been the industry workhorse for decades: durable, formable, and tolerant of high temperatures. But it is the densest material in the table and one of the worst damped ( $\eta = 0.002$ ). Its breakup typically falls within or just above the audible band, and because the resonance is undamped it radiates — the familiar dry, metallic top octave of conventional compression drivers, increasingly audible at high drive levels [3].

Aluminium is lighter and similarly stiff, but shares the same negligible internal damping, and its lower strength limits power handling in compression driver applications.

Beryllium is the benchmark on paper: its 12,500 m/s sound velocity pushes breakup beyond 40 kHz. In practice it carries serious liabilities — beryllium dust is highly toxic (inhalation can cause berylliosis, a chronic lung disease), processing is restricted to specialized facilities, and finished diaphragms cost an order of magnitude more than titanium [2][3].

Polymers and coated fabrics damp well but are too soft to maintain piston motion across a compression driver's bandwidth, and they degrade with heat, humidity, and time.

### 3. The Case for Glass

Glass — amorphous SiO<sub>2</sub> — occupies a position no other practical material does. Its sound velocity of roughly 5,800 m/s exceeds titanium's, so a glass dome holds pistonic motion at least as far up the band as the industry-standard metal. At 2.4 g/cm<sup>3</sup> it is barely half the density of titanium, reducing moving mass and supporting high sensitivity. And critically, its damping factor of 0.015 is 7.5 times that of titanium or aluminium [1]: when the dome does approach breakup, the resonance is absorbed inside the material instead of being radiated as ringing.

The amorphous structure is the key. Metals are crystalline; vibration energy travels along the lattice with very little loss, which is why a struck metal dome rings. Glass has no lattice — its disordered molecular network scatters and dissipates vibrational energy internally. The audible result is a top end with metal-like extension and detail, but without the metallic signature.

Two further properties matter in professional use. Modern thin glass is chemically strengthened by ion exchange — sodium ions in the surface are replaced with larger potassium ions, placing the surface under permanent compression and raising strength by a factor of five or more over ordinary glass [1]. And unlike paper or polymer diaphragms, glass is immune to humidity, temperature cycling, and aging: its properties on day one and day ten thousand are the same.

- Higher sound velocity than titanium → pistonic motion maintained across the working band
- 7.5× the internal damping of titanium or aluminium → no audible breakup ringing
- Half the density of titanium → lower moving mass, high sensitivity
- Chemically strengthened, non-toxic, and dimensionally stable for the life of the product

### 4. Glass in Practice: The 202N-GL

Theory is only as good as its execution. The REDCATT 202N-GL is, to our knowledge, the only compression driver in production anywhere in the world with a glass diaphragm. Glass domes have appeared in earphones and hi-fi tweeters, but forming, strengthening, and terminating a glass dome that survives the acoustic loads inside a 1.4-inch compression driver is a substantially harder problem — one REDCATT has solved entirely in-house.

#### **Proprietary technology, patent pending**

The 202N-GL's diaphragm is not a sourced component: it is REDCATT's own development from raw material to finished driver. That covers three distinct innovations — a glass composition formulated specifically for acoustic duty, the production technology to form that glass into a finished diaphragm, and the manufacturing technology to assemble the glass dome, surround, and voice coil into a driver that withstands professional power levels. Each layer represents years of in-house development, and the technology is currently patent pending. No other manufacturer has access to it.

Parameter	202N-GL
Diaphragm	Precision-formed glass dome
Exit / throat	35 mm (1.4 in)
Voice coil	3 in (75 mm), copper-clad aluminium ribbon (CCAR) on kapton former
Magnet	Neodymium
Nominal impedance / Re	8 $\Omega$ / 5.9 $\Omega$
Power handling	70 W AES, 140 W continuous, 280 W peak
Sensitivity	109.5 dB (1 W / 1 m)
Free-air resonance (Fs)	710 Hz
Surround	PEI
Dimensions / weight	112 mm dia. × 58 mm deep, 1.9 kg net

The glass dome is paired with a 3-inch copper-clad aluminium ribbon voice coil on a kapton former, driven by a neodymium motor, and suspended on a PEI surround that mechanically decouples and damps the dome's edge. The complete driver weighs 1.9 kg and is just 58 mm deep — suited to weight-sensitive arrays and compact two-way systems.

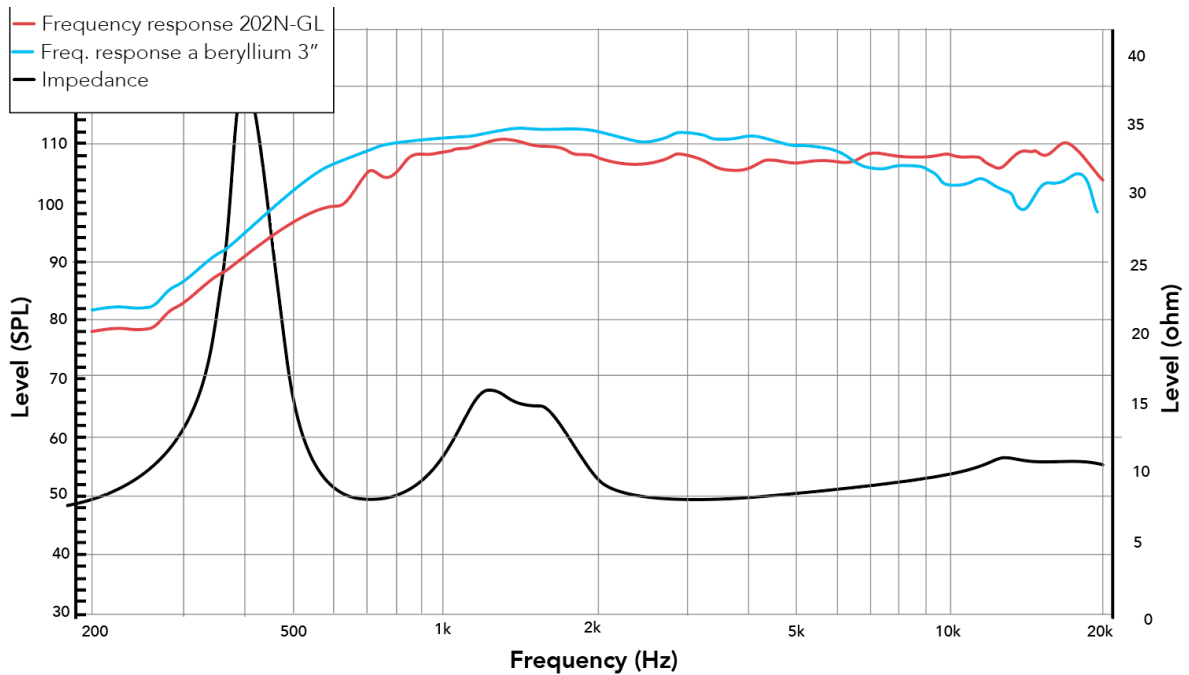
### Measured performance

Measured performance Klippel measurements of the 202N-GL fundamental response show output rising through the 500 Hz region (below the intended passband, around the 710 Hz free-air resonance) onto a plateau of approximately 108–110 dB that extends from roughly 1 kHz to 20 kHz. The plateau is notably free of the isolated high-Q breakup peak that typically appears in the top octave of titanium-dome drivers; output is fully maintained at 20 kHz. This is the measured signature of a stiff, well-damped diaphragm — and precisely what the material data predicts.

### The last octave: glass vs a premium beryllium driver

The clearest illustration of what the glass diaphragm delivers comes from comparing the 202NGL's measured response against the published response of a competing 3-inch coil compression driver with a beryllium diaphragm and a **substantially larger motor assembly**. Through the midband, the larger motor earns the competitor a sensitivity advantage of roughly 2 dB. Above approximately 7 kHz, the picture reverses: the beryllium unit's output falls away, dipping near 10–12 kHz and reaching roughly 99 dB at 20 kHz, while the 202N-GL holds 107–110 dB to the top of the audible band — an advantage of 5 dB or more in the last octave, achieved with a smaller, lighter motor.

The last octave is where high-frequency drivers are actually judged: it carries the air, sheen, and transient detail of a system. A driver that needs corrective boost at 20 kHz spends amplifier headroom and excursion to recover what the 202N-GL delivers natively.



[Figure: Frequency response comparison — REDCATT 202N-GL (glass) vs competing beryllium-diaphragm 1.4- inch compression driver, 200 Hz–20 kHz.]

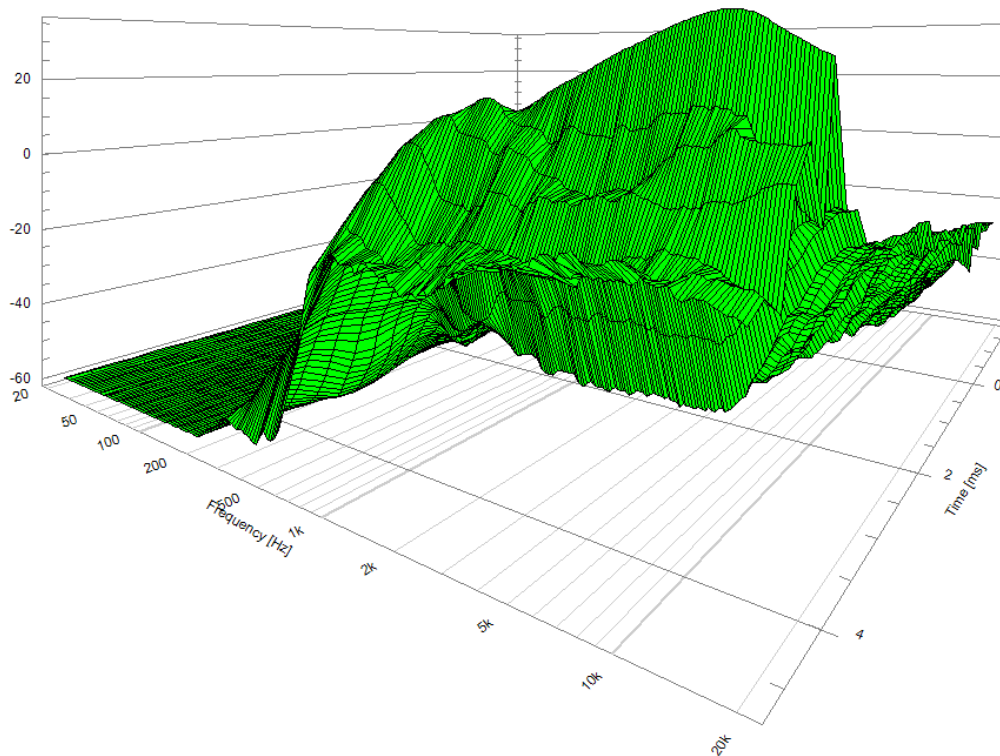
Note: the competitor curve is redrawn from the manufacturer's published datasheet; measurement conditions may differ from REDCATT's, so absolute level comparisons are indicative. The response shapes — high-frequency extension and rolloff — are as published by each manufacturer.

### Time-domain evidence: cumulative spectral decay

Frequency response shows what a driver does; cumulative spectral decay (CSD) shows what it keeps doing after the signal stops. A CSD waterfall plots the decay of stored energy across frequency and time — resonances appear as ridges that persist along the time axis, and it is precisely this lingering energy the ear hears as a material's “signature.”

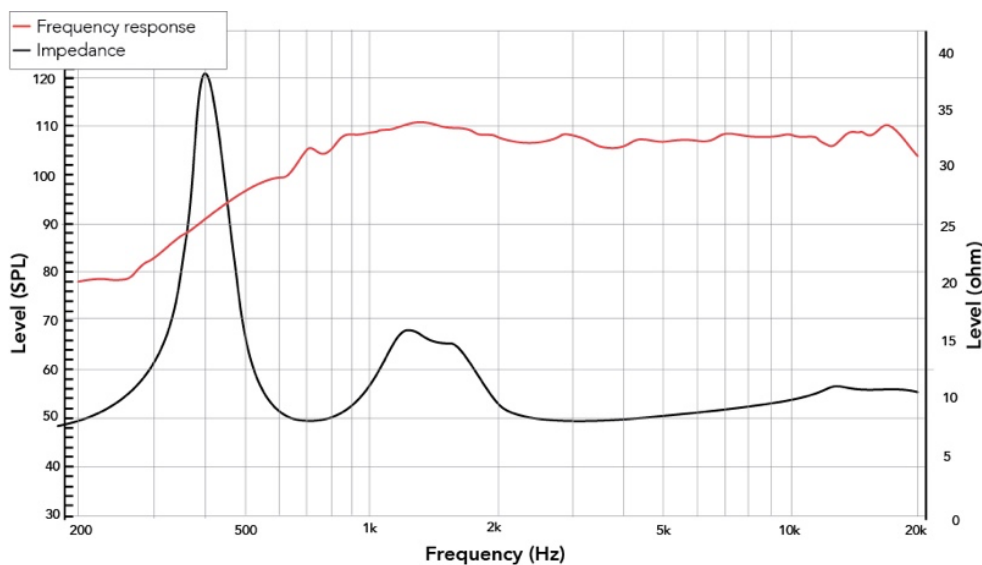
CSD measurement of the 202N-GL, displayed over a full 80 dB dynamic range from 20 Hz to 20 kHz, shows stored energy dissipating rapidly and uniformly across the working band. There are no isolated, persistent ridges in the top octaves — the pattern that betrays undamped diaphragm modes ringing after the stimulus ends. Decay behavior is consistent across the passband, which is the time-domain counterpart of the smooth fundamental response.

This is what the material data in Section 2 predicts. Even beryllium — the most highly regarded metal diaphragm material — retains the damping of a metal: its loss factor of  $\eta = 0.005$  is one third that of glass ( $\eta = 0.015$ ) [1]. Whatever energy enters a metal dome's resonant modes must ring before it dissipates; in glass, it is absorbed within the material almost immediately. Glass delivers this damping advantage without beryllium's toxicity, sourcing challenges, handling restrictions, or cost.



[Figure: CSD waterfall, REDCATT 202N-GL glass diaphragm — rapid, uniform decay, 20 Hz–20 kHz, 80 dB display range.]

In system design terms, the 202N-GL behaves conventionally: a recommended crossover of 1.2–1.5 kHz or higher (12 dB/octave minimum, 24 dB/octave preferred), standard 1.4-inch horns, and DSP protection as with any professional HF driver. The difference is what arrives at the listener: an effortless, low-distortion top end that needs no corrective equalization for breakup artifacts.



## 5. Conclusion

Diaphragm materials have historically forced a choice between stiffness and damping. Glass refuses that choice: it transmits sound faster than titanium, weighs roughly half as much, and damps its own resonances 7.5 times better — without beryllium's toxicity or cost. The 202N-GL demonstrates that this material can be engineered into a professional 3-inch compression driver and that the measured result matches the theory: smooth, extended, low-distortion output to 20 kHz at 109.5 dB sensitivity.

REDCATT believes its patent-pending glass diaphragm technology — proprietary composition, forming, and assembly, developed in-house over years — represents the most significant advance in compression driver materials in a generation. Today, the 202N-GL is the only place in the world to hear it.

## 5. See more, get samples

Further details are available on our website: <https://www.redcatt.net/products/648a>

Talk to your local rep to order samples.

## References

- [1] Nippon Electric Glass, [“Ultra-thin Glass Diaphragms, the Key to Next-Generation Quality Sound Speakers” \(2025/2026\)](#)
- [2] W. K. Chu, BDNC (Holding) Ltd., [“The use of Novel Engineering glass as speaker diaphragms: advantages, opportunities, and design hints” \(2018\)](#)
- [3] audioXpress, [“Comparative Studies on the Behavior of Beryllium, Titanium, and CN Fiber Hybrid Dome in the Last Octave”](#)
- [4] GAIT Technology, [“Glass Diaphragm”](#)
- [5] REDCATT, <https://www.redcatt.net/products/648a>