

The BMR (Balanced Mode Radiator)

Introduction

The BMR is a type of flat loudspeaker with a flat frequency response on axis and a flat power response so that it could be considered as a point source. In practice the size should be limited to some 5 cm to prove this statement for the high audio frequencies. It seems not possible to extend the performance under about 200 Hz.

Such a speaker however, could easily be completed with a woofer for the lows with a cross over at, say, 300 ÷ 500 Hz depending of the power that should be handled. This means that no cross over takes place in the range of 500 Hz to 8 kHz where the human hearing is the most sensitive.

Superfluous to say that such a rather cheap system could be of great quality.

How does it look like?



Inventors and Manufacturers

This type of loudspeaker came to the market only a decennium ago. The first ideas came earlier but were hold back by the piston model:

It was Rice and Kellogg who published a paper entitled "Notes on the Development of a New Type of Hornless Loud Speaker" in 1925, with a description of an instrument of the piston type they had recently developed. It consisted of a lightweight conical diaphragm driven by a moving coil and they deduced that it would generate a flat pressure as well as a flat power response, at least up to the point where the diaphragm started to beam. Much later:

A Balanced Modal Radiator (BMR), Graham Bank, Neil Harris, AES Convention:119 (October 2005)

The goal of a practical loudspeaker that behaves like the "perfect point source" has been long sought. Mathematical analysis shows that the general prototype for such a device does indeed exist, but it does not point to an obvious embodiment. Using this prototype, a practical flat diaphragm loudspeaker is developed, which has a substantially flat on-axis pressure response, as well as a smooth and extended power response. A fully-coupled FEA (Finite Element Analysis) model is used to investigate the intrinsic characteristics of this radiator in both the mechanical and acoustical domains. Measurements from a real prototype loudspeaker illustrate the practicality of the method.





Deben Acoustics was formed in August 2004 and is based in the UK involved in eg. the Cambridge Audio Minx 5.1 satellite speaker and their larger systems like: Cambridge Audio Aero 5.1.

e-mail: g.bank@debenacoustics.com

mail: Dr Graham Bank FIOA, Deben Acoustics, PO BOX 218, Woodbridge, SUFFOLK, IP12 4WW, UK.

Cotswold Sound Systems

This company manufactures different models. (<http://www.cotswoldsoundsystems.com/models.htm>) But before the link is gone, I copy a part of the list with the most important model:

							
 	BMR56XE N4R	Neo	3	4	BMR56XE N4R	NEW	BMR56XE
							



Cotswold Sound Systems

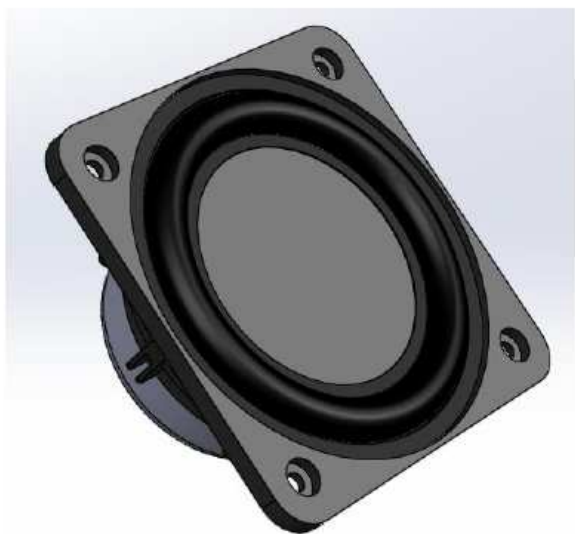
The Coach House, Burmington, Shipston-on-Stour, CV36 5AR, UK

tel: +44 (0) 7720 555 762

email: j.vizor@btinternet.com

Specification Sheet

BMR56XE N4R – 3 inch – 4ohm



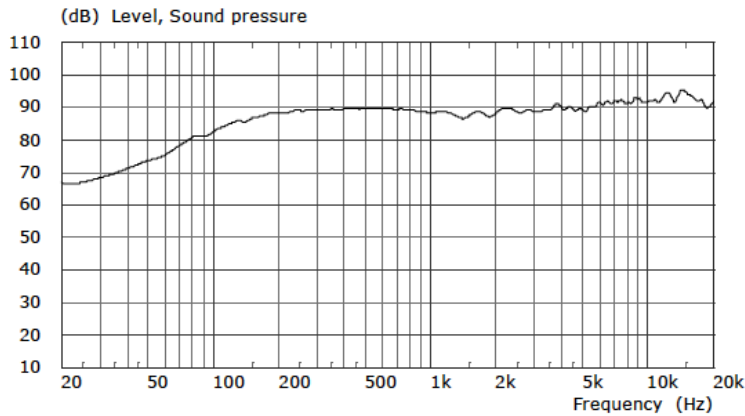
T/S parameter	value	unit
Re	4.070	ohm
Le	0.044	mH
Re2	1.792	ohm
Le2	0.128	mH
BL	3.759	Tm
Mms	2.643	gm
Cms	0.523	mm/N
Vas	0.694	litre
Rms	0.275	Ns/m
fs	135.3	Hz
Qms	8.176	
Qes	0.647	
Qts	0.600	
Sd	30.680	cm ²
SPL for 2.83 volts	89.0	dB
Max. Excursion (pk-pk)	11	mm
Power handling (IEC268-5)	TBA	W

Features

- **Balanced Mode Radiator (BMR), Internationally Patented Technology**
- **Black finish, with chassis moulded in Engineering Grade plastic**
- **High temperature magnets, with full magnetic shielding**
- **Overall dimensions: 80 mm x 80 mm x 38.5mm deep (including surround)**
- **Weight: 256 gm**
- **Available with varying grades of Neodymium**

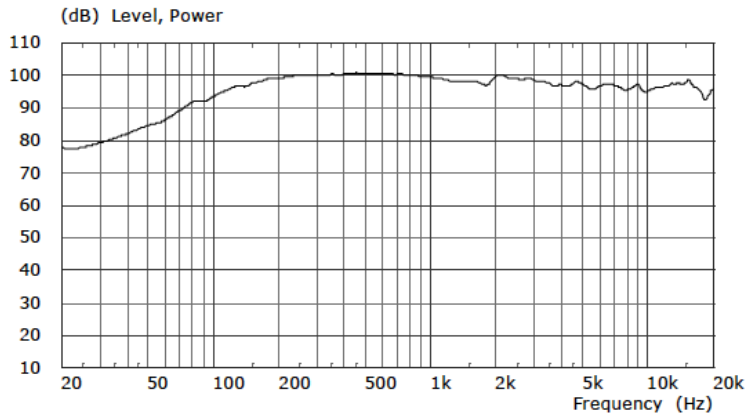
Frequency Response (on-axis):

2.83volts/1m



Sound Power Response:

(calculated)



Issue: 1

E&OE

date: 14th March 2016

Cotswold Sound Systems Ltd (CSS), which is based in the UK, designs, manufactures and distributes Balanced Mode Radiator (BMR) drive units internationally into the specialist loudspeaker market. The company operates under a Licence from NVF Tech Ltd., (formerly HiWave Technologies, formerly NXT). Whilst the company has its own exclusive range of drive units called The Inventor Series, currently available ex-China.

mail: j.vizor@btinternet.com, phone.: +44 (0) 7557922871

Cambridge Audio System

The Cambridge minx min 12 is a small box with a BMR in it:



A number of them could be completed with an active woofer. They sound great and are plenty available for 75 euro.

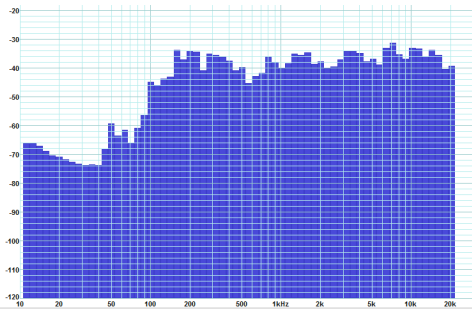
De resonantie los in de hand komt op **200 Hz** bij 37 Ω . De impedantie bij 16 kHz is $\sim 8 \Omega$, dus de spreekspoel-zelf-inductie zal zo'n 40 μH zijn.

Metten aan de MINX MIN 12

Eerst werd gevoeld en geluisterd of er geen resonanties optreden. De achterkant vertoont uitslag tussen 300 Hz en 1 kHz. Het hele kastje trilt wel wat, maar er zitten geen pieken in. Vervolgens is met roze ruis gekeken hoe

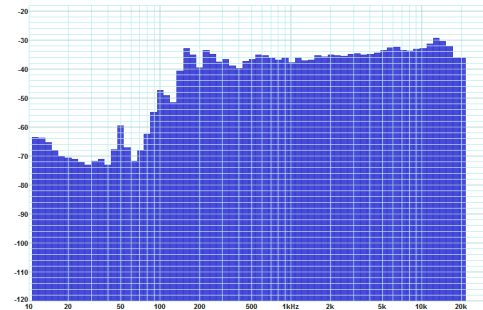
het met de frequentie karakteristiek staat onder twee omstandigheden: met de achterkant staande op de vloer zoals door Cambridge in een applicatie (tegen de muur) wordt voorgesteld en 'los in de hand'.

Hieronder staan de grafieken.



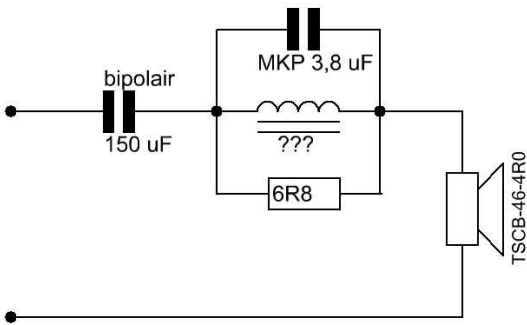
← MINX MIN 12
op de vloer

MINX MIN12 los →
in de hand



Tegen-de-wand is dus niet zo fraai als los-in-de-hand. Dat komt goed uit voor het gebruik als OmniwAve speaker. Dit is toch erg mooi!

Het correctiefilter in de MINX MIN 12 is als volgt:

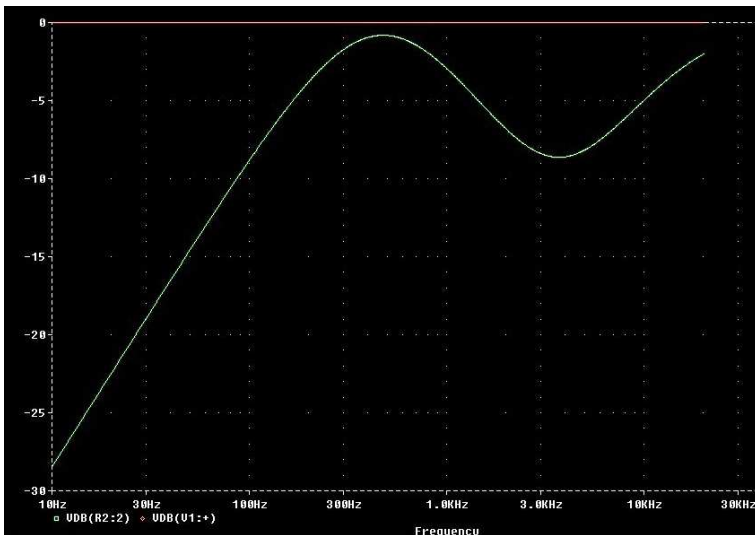


De zelfinductie is 'een bosje draad' op een stukje trafoblik met krimpkous er omheen. De resonantie komt op 3,6 kHz met de 3,8 μF er overheen, zodat de zelfinductie ruim **0,5 mH** wordt.

De 150 μF zorgt dan voor een high pass op 212 Hz tov 8 Ω . De impedantie zal daar echter veel hoger zijn. De resonantie in het kastje ligt immers op **200 Hz**.

Om misverstanden te voorkomen: het kastje is **niet** van aluminium dat strak gelakt is, zoals op YouTube verteld wordt, maar van plastic (ABS?). Prima.

Hiernaast een simulatie van het correctiefilter. De



MIX MIN 12 fungeert aardig als bolstraler. Het kastje is kubus-vormig (8 x 8 x 8 cm) dus is dat niet zo vreemd. Dat versterkt bij mij het vermoeden dat hij goed in een OmniwAve opstelling zou passen. Derhalve heb ik ze, met de conus naar beneden, een meter boven mijn huidige luidsprekers (circulaire array) gehangen om te zien of het er op ging lijken. Om te voorkomen dat ik de luidsprekertjes zou opblazen, stond er een weerstand mee in serie. Het toegevoerde signaal bevatte het hele spectrum en stond in fase met de arrays. **The sweet spot is weg (als je rondloopt) maar het maakt op de luister-plaats weinig uit.**

Tectonic Elements

Not to forget the most accessible company.

They have also a variety of BMRs of which the **TEBM46C20N-4B** is the most interesting.

Headquarters:

Tectonic Elements (UK) Ltd, Bedford i-Lab, Suite F15, Priory Business Park, Bedford, MK44 3RZ, United Kingdom

Telephone: +44 (0) 1234834709

e-mail: sales@tectonicelements.com for all sales and technical support.

Products Overview

BMR Speakers

Amplifier modules

Audio amplifier ICs

Audio Exciters

Application Notes

Terms and conditions of sale

Reach statement



BMR Speakers

The tables below show the currently available BMR® speakers. These combine bending wave technology with pistonic motion to create full audio range, wide-dispersion speaker drivers for life-like sound reproduction.



Part No.	Continuous Power Rating	Nominal Impedance	Notes	Maximum Outside Diameter (mm)	Thickness (mm)	Mass (g)	Datasheet	Buy from RS
Square BMRs								
TEBM36SQ5-4	5W	4 ohm	Square BMR	58 x 58	20.6	65	Download	Buy
TEBM36S12-4/A	12W	4 ohm	Square BMR	65 x 65	29.7	88.2	Download	Buy
TEBM36S12-8/A	12W	8 ohm	Square BMR	65 x 65	25.7	88.5	Download	Buy
Round BMRs								
TEBM35C10-4	10W	4 ohm	-	54	25.1	51.3	Download	
TEBM46C20N-4B	20W	4 ohm	-	75	34.7	194	Download	Buy
TEBM46C20F-4	30W	4 ohm	Ferrite	108	57	685	Download	Buy
TEBM46C20F-8	30W	8 ohm	Ferrite	108	57	685	Download	Buy
Rectangular BMRs								
TEBM98H10M-8	10W	8 ohm	10W BMR	97 x 29	28	62	Download	Buy
TEBM130H10-8	10W	8 ohm	10W BMR	131 x 29	29.3	95	Download	Buy

TEBM46C20N-4B Data Sheet

TEBM46C20N-4B Data Sheet

Tectonic Elements

TEBM46C20N-4B Balanced Mode Radiator



Features

- Wide bandwidth and wide directivity
- Impedance: 4 ohm
- Dimensions: 75mm x 75mm
- Thickness: 34.65mm
- Mass: 194g

Applications

- Sound bars
- Portable speakers
- Internet radios
- Docking stations
- Wireless speakers

Parameters

Parameter	Description	min	typ	max	Units
R_{dc}	DC resistance	-10%	3.94	+10%	Ohms
L_e	Inductance	-10%	0.03	+10%	mH
BL	Force factor		4.49		Tm
f_r	Resonance frequency	-20%	170	+20%	Hz
dDriv	Voice coil diameter		32		mm
M_{mc}	Moving mass		2.26		g
C_{mc}	Compliance		0.39		$g \text{ mmN}^{-1}$
R_{mc}	Suspension Loss		0.16		Nsm^{-1}
X_{max}	Maximum coil excursion (p-p)		8.0		mm
S_d	Effective piston area		19.6		cm^2
V_{AS}	Equivalent volume		0.32		L
Q_{ms}	Mechanical quality factor		15.16		
Q_{es}	Electrical quality factor		0.47		
Q_{ts}	Total quality factor		0.46		

Description

The TEBM46C20N-4B Balanced-Mode Radiator (BMR) is an audio drive unit with an extended frequency response and wide directivity compared with a conventional drive unit. It combines the benefits of Tectonic Elements bending-wave technology and pistonic modes of operation. It is ideally suited for compact audio applications that require a full-range, high performance acoustic solution.

Operating conditions

Condition	Value
Continuous power handling (IEC 268-5 weighted pink noise, 150Hz high pass filter)	20W
Operating temperature range	-20 to 55° C
Audio frequency range	150Hz to 20kHz
Sound pressure level @ 1W, 1m	86 dB

Response

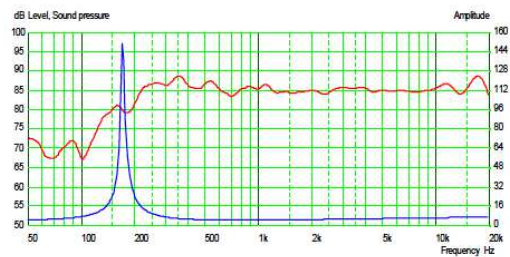


Figure 1. On-axis SPL at 1W, 1m (in-room), & impedance vs. frequency

Outline Drawing

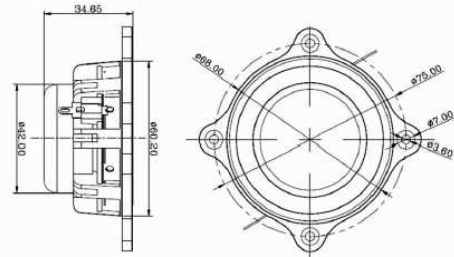


Figure 2. Nominal dimensions