

# Graham Audio Chartwell LS3/5 Monitor Speaker

The BBC's legendary LS3/5A is arguably the Godfather of nearfield monitors — and now it's back, thanks to UK company Graham Audio.

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**I**ntrepid readers may recall a feature I wrote back in 2011 on the history of the venerable Yamaha NS10. Well, I'm at it again with another story of electro-acoustic derring-do. My subject this time is a monitor that, while perhaps not as well known as the iconic Yamaha, has been in its own way similarly influential in monitor design over the last four decades or so. It's also a monitor that, if your work falls regularly into the small-scale folk,

singer-songwriter, acoustic jazz or classical genres, and you don't have much space in your studio, you would do well to hear.

The monitor in question is the BBC LS3/5A, and there's a story here worthy of a soap opera plot, including the lead character dying and being brought back to life. To illustrate the story, and compare old with new, I've been loaned a pair of Graham Audio Chartwell LS3/5s. Note the lack of an 'A' at the end of the product name: it's not a typo, it's part of the story.

Graham Audio are a relatively recent

commercial endeavour founded by Paul Graham. He's a man of long experience in the professional audio, theatre sound and broadcast sectors, and his company were born of a fascination with the monitor speakers that came out of the BBC's Kingswood Warren research labs in the 1970s. Graham Audio began with reincarnations of the classic BBC LS5/9 and LS5/8 systems that became standard issue in BBC TV studios across the UK and around the world, but have now introduced a revived BBC LS3/5.





The bijou (30 x 19 x 17cm) LS3/5, or more particularly, its close sibling the LS3/5A, is without doubt the best known of all the BBC-designed monitors. They are especially revered among audiophiles in the USA and Japan, and a quick search on eBay will reveal that a pair of original, unadulterated LS3/5As in good condition will command a sum that often reaches four figures. That is a lot of money for a couple of very small passive speakers that are likely to be between 20 and 40 years old.

The LS3/5 (and LS3/5A) originated in the mid-'70s, at a time when the BBC designed a fair proportion of their own broadcast and studio equipment. The whole idea of state-owned broadcasters designing and building their own kit is all but unthinkable now, but right up until relatively recently, if the BBC found themselves needing a specific tool that wasn't available commercially, Kingswood Warren were tasked to come up with the goods.

The genesis of the LS3/5A was not as straightforward, however, as the Kingswood Warren boffins simply being asked to design a compact monitor and dutifully delivering. Although there was a need at the BBC for a 'Grade II' compact monitor for use in outside broadcast trucks, the development of the speaker that became the LS3/5A didn't kick off in direct response to such a request. In fact the progenitor was a speaker designed for one-eighth-scale acoustic modelling of concert halls...

### It's Only A Model

Long before 'virtual' computer-based acoustic modelling of performance spaces was possible, such work was done using literal modelling techniques. A physical scale model of the space would be built and miniature speakers and microphones placed appropriately within it to analyse its internal acoustic characteristics.

## Graham Audio Chartwell LS3/5 £1650

### PROS

- Perfectly natural tonal balance and uncoloured mid-range.

### CONS

- Bass extension and maximum volume level relatively limited.

### SUMMARY

A really classy reproduction of the speaker that effectively started the compact nearfield monitor business.

Now, there is no record (well, not in any document I've found) of who the engineer was to whom it first occurred that the acoustic modelling speaker used at Kingswood Warren actually sounded pretty good and might form the basis of a compact monitor. But whoever it was, I'd wager they had no idea at the time how significant a lightbulb moment they'd had.

In the early 1970s, when our story begins, speakers, whether for domestic or professional applications, were on the whole pretty big. Stereo hadn't really been around all that long, and neither had powerful transistor amplifiers, so a single, large speaker was still the norm. Now, even if it's on the large side, positioning one speaker is far easier than positioning a pair, as is required to create a stereo image, so the physical size of the speaker wasn't so much of an issue. With stereo, however, came the problem of speaker positioning, and with that not only came the need for speakers to be smaller, but also for pairs of speakers to be closely matched in terms of performance.

It hardly seems believable now, but back then, there were very few commercially available small speakers that would satisfy the BBC's needs. One of those few speakers that was available to the BBC was the original Goodmans Maxim, and a 1965 internal Kingswood Warren report describes its performance and assesses its potential. The report was written by Dudley Harwood, who went on to found Harbeth Audio (the company name being a conjunction of Harwood's name and that of his wife, Elizabeth). The Goodmans Maxim itself was designed by a young Laurie Fincham, who went on to become Technical Director of KEF, manufacturers of the drive units eventually used in the LS3/5A. There's none of that 'six degrees of separation' stuff in the British loudspeaker business; one or two degrees will usually suffice.

Harwood's Maxim report, which can be found at <http://downloads.bbc.co.uk/rd/pubs/reports/1965-09.pdf>, makes interesting reading (well, it does if, like me, you're irrationally interested in the history of speaker design). Even without converting the archaic imperial measurements of the test results, it's obvious that the Maxim, by today's standards, was inefficient, had restricted bandwidth at both ends of the spectrum, and displayed precious little power handling. However, those shortcomings weren't issues that Harwood expressed much concern over; in fact he was generally satisfied with the Maxim's performance. The issue that

## Full Circle

Not long after the LS3/5A project was put to bed, Dudley Harwood followed Spencer Hughes' example and left the BBC to start his own speaker company: Harbeth (still trading very successfully but no longer in the Harwood family). It wasn't just the idea of leaving the BBC and building speakers that Harwood borrowed from Hughes: the name he chose for his company, 'Harbeth', is a conjunction of Harwood and his wife's name, Elizabeth. Those with memories for nearfield monitors may remember the HHB Circle products of the late 1990s; they were designed and manufactured by Harbeth.

was of most concern to Harwood was sample consistency.

Along with the basic requirement for a small speaker that performed adequately for broadcast quality monitoring, the BBC needed the speaker to be consistent from sample to sample. If, say, a single speaker in an OB truck failed, it would be decidedly inconvenient if the pair had to be replaced, and equally unsatisfactory if the second pair didn't sound the same as the first. So each individual speaker was required to perform within response limits that, even today, are a challenge. If the Goodmans Maxim report revealed one thing, it was that this degree of consistency would not likely be found in an existing commercial speaker. So, with a concept on the table for a design inspired by the acoustic modelling speaker, the Kingswood Warren engineers turned to KEF Electronics for help.

## Driving Force

KEF got the call partly because, now under Laurie Fincham's engineering leadership, the company were by some distance the most technologically advanced in the field, and partly because there was already an established relationship with the BBC. An earlier research project at Kingswood Warren into thermoplastic diaphragm materials had resulted in driver cones made from Bextrene (a polystyrene-based sheet material most often used in packaging and plastic consumables), and KEF were the first speaker manufacturers to commercialise the development, with their B110 five-inch bass/mid driver. Coincidentally, a five-inch bass/mid driver was also just about the right size for the speaker Kingswood Warren had in mind. And just as conveniently, KEF had developed an advanced (for the time) 27mm-diameter high-frequency driver, called the T27.

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» The Kingswood Warren speaker engineers believed that drivers with thermoplastic diaphragms were, along with their fundamental performance advantages, likely to offer better consistency than drivers with traditional 'paper' diaphragms. They were, of course, correct in general terms: sheets of plastic do tend to be more consistent in physical characteristics than sheets of paper. However, the diaphragm is just one among many potential sources of inconsistency in a driver, and the B110 had a couple that particularly caused headaches. Firstly, sample differences in the mechanical properties of the driver's neoprene diaphragm surround resulted in variable frequency-response anomalies, and secondly, in order to perform optimally, that Bextrene diaphragm required a coat of tacky gunk, called Plastiflex (a book-binding adhesive closely related to PVA wood glue), applied to its surface to provide extra damping. The problem with the layer of Plastiflex was its application — by hand with a paint brush — which meant that the mass of the diaphragms would vary, and changes in the baseline sensitivity of individual drivers would result.

Despite these potential consistency issues, the B110 and T27 were chosen for the LS3/5, and the remainder of the development just required an enclosure and passive crossover. Remarkably, there's no need for me to spend too many words going into the detail of the design of the enclosure or crossover, because it's all documented in another BBC Research Department report, again by Dudley Harwood: <http://downloads.bbc.co.uk/rd/pubs/reports/1976-29.pdf>.

Harwood's LS3/5A report is fascinating throughout, but a couple of things stick out for me. Firstly, significant effort was clearly expended on fine-tuning the LS3/5A cabinet — even to the extent that the variety of wood used for the internal batons was driven by the influence this had on subjective sound quality. The cabinets also were built from a tightly specified grade of birch plywood, and incorporated not only elaborate internal panel damping but even constructional techniques designed to ensure that screw holes were guaranteed airtight. Secondly, the sample variation of the B110 mass/mid driver meant that an unusual tapped inductor was used in the crossover network, so that the effective sensitivity of the tweeter could be adjusted

An original pair of Rogers LS3/5A speakers (complete with original Rogers badge!).



to compensate for the sensitivity of individual bass/mid drivers. The crossover network is a complex one also, with as many elements dedicated to equalising the pass-band frequency response of the drivers as there are dedicated to low- and high-pass crossover filtering.

If you've read Harwood's LS3/5A report, you'll know that the project hit a snag after the first 20 prototype pairs were made. The snag was that KEF had modified both the B110 bass/mid driver and T27 tweeter for their own needs, and so the LS3/5 design had to be revised to compensate for the changes. This is the point at which the LS3/5 became the LS3/5A (in fact the Harwood report primarily covers the LS3/5A).

### Beeb The Builder

While the original LS3/5 became a small historical footnote, the LS3/5A was a huge success, and as well as building units in-house, the BBC took the decision to offer licences for its commercial manufacture and sale to the general public. There were two motivations behind the licence decision; firstly it meant that in-house demand for the monitor could also be more easily satisfied (by the mid '80s, it's said that around 3500

were in use by the BBC), and secondly, selling licences was an effective way of recovering the speaker's development costs. These were estimated at well over £100,000 — a very significant sum back in the mid-1970s. A maximum of three licences were available at any one time.

Gaining a licence to manufacture the LS3/5A was no small undertaking, as it required manufacturers to work far harder on quality control and manufacturing consistency than had been typical in the speaker business. Even today, the terms of the licence are challenging. The first three licensees were Rogers, Audiomaster and Chartwell, but in subsequent decades KEF, Spondor, Harbeth, RAM, Goodmans, Falcon Audio, Stirling Broadcast and, of course, Graham Audio have all held licences to manufacture the monitor. It's estimated that around 100,000 pairs in all were built from around 1975 to the late 1990s.

### The Next Chapter

The LS3/5A story should probably have ended in the late 1990s, when KEF ceased production of the B110 and T27 drivers. And, for a while, it did... But the speaker never lost its appeal, especially among a niche group of audiophiles, and in more recent times, new versions of the monitor, based on drivers specifically manufactured or selected to duplicate the characteristics of the B110 and T27, but still requiring a BBC licence, have appeared. One of these is of course the Graham Audio LS3/5.



Paul Graham's decision to base his entry to the LS3/5A market on the LS3/5 not only won the speaker a little differentiation from the competition, but has also brought back to life a little piece of electro-acoustic history. A nice touch also was the decision to christen the speaker a 'Chartwell', in acknowledgement one of the original licensed LS3/5A manufacturers.

Four decades removed, however, it's not all that easy to establish exactly what constitutes an LS3/5 and how it is different from the LS3/5A. While it is said by some that a couple of examples from the first 20 pairs are still around, their provenance is said by others to be less than watertight, so there was no definite reference to aim at. Some details are known, however. There were differences in cabinet specification and construction, and the LS3/5 crossover topology was less complex because the earlier versions of the B110 bass/mid driver required less equalisation. The LS3/5A also gained a perforated metal grille over the tweeter dome and some strips of absorbent foam around the tweeter, intended to suppress cabinet edge diffraction.

So, while Graham Audio's Chartwell LS3/5, being based on contemporary drivers, can only hope really to offer the character of the original LS3/5 rather than an exact clone, it does have a direct engineering link back to the BBC Kingswood Warren days: Derek Hughes, the speaker consultant who designed it. The Hughes family comes as close to British speaker industry royalty as any. Derek's father, BBC speaker engineer Spencer Hughes, was an integral part of the design team at Kingswood Warren and worked closely with Dudley Harwood and the other engineers directly responsible for the LS3/5 (Donovan Shorter, Maurice Whatton, Ralph Mills and Derek Mathers are the other names most often associated with speaker design at the BBC in the 1970s). Spencer Hughes founded

his own hi-fi speaker company while still with the BBC (see 'Full Circle' box), and went on to have considerable commercial success, particularly with the BC1 — a monitor inspired by the LS3/6, which, ironically, the BBC went on to purchase in large quantities.

With no KEF drivers available, the Graham Audio LS3/5 relies on the combination of a Norwegian-made tweeter from SEAS, selected because of its similar dome behaviour and dispersion to the T27, and a bass/mid driver newly designed and developed by Derek Hughes specifically to replicate the B110 (and not just any B110, but the preferred variety originally used at Kingswood Warren). The new driver is manufactured by Volt loudspeakers in Dorset. Volt founder David Lythe is another engineer with roots back to the 1970s British speaker industry.

### Golden Grahams?

So after all the convoluted history, what is it about the LS3/5A that its fans, including me, so admire, and does Graham Audio's Chartwell LS3/5 capture it? To provide context and help answer those questions, along with the review pair of Chartwell LS3/5s, I also arranged to borrow a pair of original, untouched (but performance-tested) Rogers LS3/5As. The LS3/5As are the precious property of Pete Thomas of PMC, and many thanks are due to him for trusting me with them.

To answer the first question, the LS3/5A's strengths are the result of a combination of things. Firstly, as a small, closed-box speaker, its low-frequency time domain performance is good. There's no great low-frequency bandwidth extension or volume available, but the bass that is present is accurately pitched and exhibits no boomy or slurred effects. Secondly, the tonal balance of the LS3/5A, especially through the voice region, is as near perfect as you'll probably ever hear. And it's not just that the balance is reliable in simple tonal terms; there's a natural and uncoloured quality to voices reproduced via LS3/5As that is unusual for any speaker at any price. And of course, tonal accuracy on voice translates to the same kind of performance on all acoustic instruments and spaces. If you want to know what, say, a cello recording *really* sounds like, a pair of LS3/5As will tell you.

And what about the comparison of the new LS3/5 and the old LS3/5A? Does the new one have what it takes? Undoubtedly, yes. There are some minor differences in high-frequency balance, with the new LS3/5 generally being slightly brighter than the

### Alternatives

Along with Graham Audio there are two other LS3/5A licence holders currently manufacturing versions of the monitor: **Falcon Acoustics** and **Stirling Broadcast**. Additionally, the **Spendor S3/5R** and **Harbeth Monitor 20.1 Pro** are both heavily LS3/5 inspired monitors. There's also eBay, with its healthy turnover of original LS3/5As. Personally I'd be very wary of buying on eBay without asking lots of questions and doing my research. The web site [www.ls35a.com](http://www.ls35a.com), run by Maurice Whatton's son Paul, is hugely useful in that respect.

old, but the LS3/5A magic is all present and correct, and of course by employing drivers constructed with contemporary materials and adhesives, the new LS3/5 is likely to be significantly more reliable and rugged than the original LS3/5A.

So I've spent some time describing a small passive monitor that's limited in low-frequency bandwidth and maximum volume level. How, I hear you ask, is this relevant to modern-day music production? I'd make two points. Firstly, music is fundamentally about communication, and the LS3/5 (and the LS3/5A) is one of the great communicators among speakers. It has similarities with the Yamaha NS10 in that respect. We may not always like what we hear, but with monitors like the LS3/5 and NS10 that will be because what's playing isn't very good. The LS3/5's ability to communicate the guts of music so effectively has its roots, I think, not only in the fundamental quality of its component parts and construction, but also in the care and attention to detail that was invested in the original design. Such investment is pretty rare in contemporary monitor design. Secondly, back in the mid 1970s, the LS3/5A demonstrated that it was possible to engineer a very small speaker that worked as a monitor. A quick look at the pro nearfield monitor market today reveals countless small speakers that, to some degree, owe their existence to the LS3/5A. In no particular order, I'd include the Amphion One12, the Neumann KH120, the Unity Audio Pebble, the Fostex PM series, and numerous compact Genelec and Dynaudio products. The list goes on, but if you want to hear what the original sounded like, try the Graham Audio Chartwell LS3/5. ■■■

### Further Reading

I've included links to a couple of BBC research reports, but the web site they are found on actually contains hundreds of such documents dating from 1933 to 1996. So if you want to know, for example, what Dudley Harwood thought of the Neumann U47 microphone in 1954, it's here: <http://downloads.bbc.co.uk/rd/pubs/reports/1954-23.pdf>. The list of available reports is here: <http://downloads.bbc.co.uk/rd/pubs/reports/bbc-rd-report-list.pdf>. Don't blame me if you find yourself wasting hours endless hours reading.

**E** Cherry finish £1650, rosewood finish £1800. Prices are per pair, including VAT.  
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