

LINDEMANN MUSICBOOK:55

POWER AMPLIFIER

Many electronics designers say that the newest amplifier design on the block, Class-D, is still 'a work in progress', such that each new Class-D design is an improvement on earlier versions and implementations. If it were true—and I'm not necessarily saying it is—it would certainly not be surprising, because although the concept of Class-D has been around for more than half a century, practical implementations of the Class-D circuit have only been around since the turn of the century. †

There are many completely different types of Class-D amplifier, because there are many different ways of getting transistors to switch on and off rapidly enough to be able to derive an analogue audio signal, including pulse width modulation (PWM), pulse density modulation (PDM), delta-sigma modulation (DSM) and self-oscillating modulation (SOM). It is worth noting that all these systems are actually analogue—it's a misnomer that the 'D' in Class-D stands for digital... it's actually an analogue switching amplifier.

THE EQUIPMENT

Readers familiar with Lindemann's range will immediately recognise the musicbook:55 as being a Lindemann product, because it's presented in exactly the same livery as all Lindemann's other products: amplifiers, DACs, Network Players, etc. This means that not only is it gorgeous, its size and cosmetic appearance are also a perfect match for those products, which will be of immense importance to the fashion-conscious member of your household.

As you'd expect of any power amplifier, there aren't many controls on the musicbook:55: not to put too fine a point on it, there are none at all. There's a 240-volt mains power switch on the rear panel, and that's it. (Sure, there's a small rotary switch to adjust the amplifier between the available stereo, mono-biamp and mono-bridge modes, plus a really teensy toggle to switch between the XLR and RCA inputs, but I don't really count

these as true 'controls'.) Although volume controls are increasingly becoming a rarity on audio power amplifiers, so I cannot take Lindemann to task for not providing one (or two) on the musicbook:55, I can't help but bemoan the disappearance of the volume control in general... but back to the small rotary switch used to switch modes, it's rather like a tiny trim-pot and must be turned via a tiny screwdriver (Philips or flat-blade).

The problem is that there's no indication of which setting is which... or at least I didn't think there was until I mentioned this to my son, who said it would be stupid not to have some indication. When he looked, he told me that one of the four 'slots' into which you place the screwdriver was arrowed at one end, whereas the other three had squared-off ends. So it will be simple if you have better eyesight than me! The switch will come pointed at '1' (stereo) from the factory, and if you want to bi-amp you'd turn it a quarter-of-a-turn to

† One of the earliest Class-D patents was granted to none other than Amar G Bose, founder of Bose Corporation, whose research for his PhD thesis later resulted in him being granted a patent [Signal Translation Employing Two-State Techniques, Patent No. 3,294,981] for a non-linear Class-D power amplifier 'way back in 1966.

the right ('2') and to bridge the two channels to mono, another quarter-of-a-turn to the right ('3'). The last position is labelled '0' and described as 'Reserved', but I think this is just another way of saying 'Not Used'.

As for that lack of a power switch on the front panel, Lindemann has that covered by way of providing the musicbook:55 with automatic power switching. Lindemann's

Visually gorgeous: a feast for the eyes. It's so beautiful I would have liked it if Lindemann had made it twice or even four times as large

auto-switching circuitry is smarter than most, such that the musicbook:55 will switch on automatically whenever it detects an audio signal at its input. It will do so within two seconds if it's in 'idle' mode, which is when the amplifier is actually switched off, but the power supply is switched on. If both the amplifier and power supply boards are switched off (leaving only a standby sensor powered-up), switch-on takes around eight seconds. When no audio signal is detected at the musicbook:55's input, the amplifier will wait for around 30 minutes, then switch to 'idle' mode, leaving the power supply switched on. If no audio signal is detected for a further 30 minutes, the power supply is switched off, leaving only the sensor itself active, waiting for an audio signal to bring the amplifier back to life. Power consumption in idle mode is around one-watt, and in standby mode, around half that again.

The rear panel has both balanced (via XLR) and unbalanced (via RCA) line-level inputs. The speaker terminals are those odd 'safety' shrouded banana terminals that were first used by Naim but are now, since Europe has tightened up on its electrical safety regulations, becoming more common on European amplifiers (Lindemann is headquartered in Germany). It's particularly useful to use this type of terminal with Class-D amplifiers, because on many of them the negative speaker terminal is not at ground potential, as it mostly (but not always!) is with Class-A/B amplifiers, so accidentally grounding the negative terminal of some Class-D amplifiers

could damage them. Although practical, this type of terminal does make it difficult to source the necessary connectors to which you'd attach your speaker cables. All hi-fi dealers who sell Lindemann will be able to sell you the necessary connectors, but it would have made sense for Lindemann to include some with the musicbook:55.

Popping the top of the Lindemann musicbook:25 to have a butcher's inside, I wasn't surprised to discover that Lindemann has used PCBs designed and made by two other specialist manufacturers. The musicbook:55's switch-mode power supply (SMPS) is made in China to a design originally developed by Philips but whose copyright is now owned

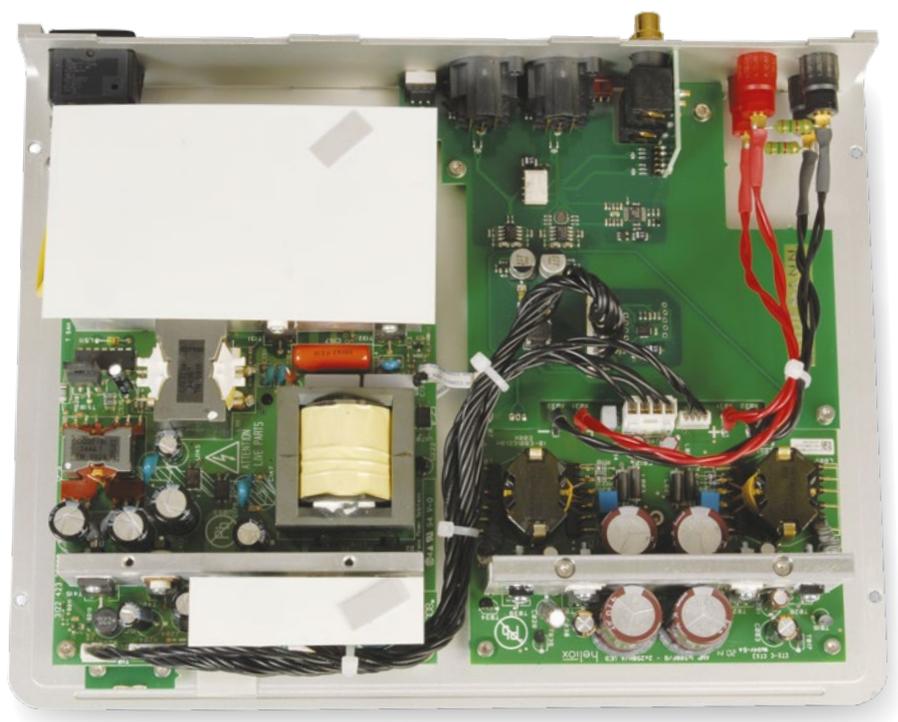
by Bobitrans Power Solutions of Spain. The Class-D amplifier module is made in Batam, in Indonesia, for a Dutch company called Heliox that specialises in building SMPSs and Class-D amplifiers. The particu-

lar Heliox module used in the Lindemann musicbook:55 is a two-channel half-bridge design using the SOM technique, where the oscillation conditions are created by a phase shift in the feedback loop between the output terminals to the input terminals, apparently patented by Heliox and called 'UCD'. The main advantages of this particular technique is that because the output filter is included in the feedback loop it has no affect on performance, plus there's no need for a Zobel network, which means output impedance is very low and the amplifier can deliver full power into loads as low as 2Ω . The input circuitry is designed and manufactured in Germany by Lindemann itself. I was not surprised that Lindemann is using OEM SMPS and Class-D modules, because both circuits are fiendishly difficult to design and build. Because of the multinational nature of the build, there really should be a label affixed to the underside of the musicbook:55 that says 'Assembled in Germany.'

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IN USE AND OPERATION

For the purpose of this review I paired the musicbook:55 with Lindemann's musicbook:25 Network Music Player, which was a match made in heaven... well, Germany really. I know the musicbook:25 was given a rave review in this very magazine by my fellow reviewer, Hugh Douglas [*Australian Hi-Fi Magazine Volume 47 No 2*], and you





should read that review for a full report and his conclusion, but I just have to add my half-pence worth, because I found Lindemann's musicbook:25 to be an absolutely fabulous component... I think I liked it even better than Hugh appeared to. It's also one of the first Network Music Players I've ever used that connected instantly and perfectly to my home computer network without any fussing around, and once connected, it stayed connected: no need for re-boots. I also loved the interface, which worked seamlessly and satisfyingly with both with my little iPod and with my iPad. [Editor's Note: *The Lindemann musicbook:25 review is now online at: www.tinyurl.com/ahf-mb25-review*]

But if I loved the musicbook:25, I also loved the musicbook:55. First up, like the musicbook:25, it's visually gorgeous: a feast for the eyes. It's so beautiful I would have liked it if Lindemann had made it twice as large as it is, or even four times as large. Space isn't an issue at my place, and I do like 'big' components, just as I'd take an eight litre V8 over a fuel-efficient three-lunger any day of the week. But enough of my personal philosophy and onto the nitty-gritty of the musicbook:55's sound quality.

Just like the unit looks, the musicbook:55's bass is also gorgeous. It goes deeper than you'll ever need, lower than the deepest synth I've ever heard played and even when it's reproducing low notes, there's no 'waffle' there at all, just clean bass that's always perfect for the instrument it's reproducing: silky-smooth with bowed double-bass or cello, and hugely impactful with slapped bass or percussion. There's no overhang, no ringing, exceptional tonality... I can't enthuse enough about the pellucidity of its bass. I absolutely loved using the musicbook:55 to listen to Club Cheval's new album, *Discipline*, with my favourite track to demo the musicbook:55's bass to visitors being the first 30 seconds of the track *Legends (Intro)*, though the bass in the track from which the disc takes its name is just awesome!

Your only real decision will be whether to buy the musicbook:55 or its seemingly identical but rather lower-powered twin, the musicbook:50

The midrange surprised me, not because it was so great-sounding (which it was), but because the tonal quality reminded me of some of the better valve amplifiers I've heard... and that's something I don't think I've ever said before about a Class-D design! Although tonally accurate and well-balanced against the bass, it has that soft, silky tone that seemed to wrap a gossamer veil around every vocalist, though most attractively with female vocalists, as was comprehensively proved to me when listening to Lapsley's *Love is Blind*, from her debut album *Long Way Home*. Although much of the backing on this album is over-produced, as is her voice when it's multi-tracked, when she's singing solo I could—thanks to the musicbook:55—hear perfectly clearly her unique vocal attributes. But the clarity of the musicbook:55's midrange also let me hear the heavy-handed engineering, so it clearly didn't pull a gossamer veil over this.

Also surprising was the treble, this time because I auditioned it with pub rock band Bad Dreems's debut album, *Dogs At Bay*. 'Judging treble using a garage rock band?' I hear readers decry. Yep, guilty, but first I was using vinyl and second, there's just so much high-frequency energy in this album that if the amp doesn't get it right, the result is just ear-glazing sizzle. The musicbook:55 got the treble exactly right—pure high-frequency energy, but excitingly real, as *Ghost Gums* is my witness

(or any of the other tracks on this fabulous album. If you can't find the LP, stream it!).

CONCLUSION

As you can see, I have had nothing but good things to say about Lindemann's musicbook:55 power amplifier, and it's on that note that I will conclude this review: It's a great little amp. If you're thinking about a musicbook:25 Network Music Player—and, even from my brief exposure, you should be if you're looking for a Network Music Player (and don't forget it's a CD Player and DAC as well)—your only real decision will be whether to buy the musicbook:55 or its seemingly identical (but rather lower-powered) twin, the musicbook:50. And even that's an easy decision: small room—musicbook:50; big room musicbook:55. Go for it! *Leslie Dudman*

Readers interested in a full technical appraisal of the performance of the Lindemann musicbook:55 Power Amplifier should continue on and read the LABORATORY TEST REPORT published on page 22.

CONTACT DETAILS

Brand: Lindemann
Model: musicbook:55
Category: Power Amplifier
RRP: \$4,460
Warranty: Five Years
Distributor: Audio Magic
Address: 23/22 French Avenue
 Northcote VIC 3070
T: (03) 9489 5122
E: info@audiomagic.com.au
W: www.audiomagic.com.au



- High power
- Size and appearance
- Superb sound



- Speaker terminals
- Volume control

SEE LAB REPORT ON PAGE 22

LABORATORY TEST RESULTS

The Owner's Manual provided with the musicbook:55 says the amplifier is rated to deliver a power output of 240-watts into 4Ω loads for durations of less than one minute. *Newport Test Labs* found it delivered around 0.6dB less than this, albeit over a little longer period of time: 205-watts per channel (single or both channels driven into 4Ω). Lindemann does not provide a power output specification into 8Ω loads, but *Newport Test Labs* measured 110-watts per channel into 8Ω. (The musicbook:55's protection circuit triggered automatically when the laboratory attempted to measure power output into 2Ω, hence the lack of results for this test load.) The protection circuit auto-resets very quickly, so once the 2Ω load was replaced with a higher resistance, the protection instantly reset itself—no user intervention was required.

The frequency response of the musicbook:55 was measured as extending from less than 1Hz to 45kHz -1dB, and from less than 1Hz to 63dB -3dB, as shown in the accompanying results table. Channel separation was measured as 67dB at 20Hz, 70dB at 1kHz and 61dB at 20kHz. Although these are all satisfactory results that will enable excellent sonic performance, I am used to seeing higher separation figures returned by power amplifiers. Channel phase errors were low at the same frequencies, as you can see from the tabulated figures but these results are fairly typical of a power amplifier and in any case would not be audible.

Overall distortion (THD+N) was measured by *Newport Test Labs* at 0.023% for an output of one watt, and 0.18% at an output of 100-watts. These are good results, but you have to remember that they're band-limited as a result of the lab having to use a 20kHz low-pass filter to prevent switching noise from the amplifier affecting the test instruments. [**Editor's Note:** *I am advised that as a result of the number of Class-D amplifiers now being tested, in future the lab will be using an 80kHz low-pass filter to remove switching noise.*] The harmonic spectra of the musicbook:55's output is shown in Graphs 1 through 4.

Graph 1 shows performance at one watt into an 8Ω load, and there's a second harmonic at -70dB (0.0316%), a third at -90dB (0.0031%) a fourth at -110dB (0.0003%), a sixth at -112dB (0.0002%) and a seventh at -107dB (0.0004%). You can see that the noise floor is over 100dB down at low frequencies, and 120dB down across the rest of the audio band. Results into a 4Ω load at one watt (Graph 2) show an increase in distortion, with the second harmonic sitting at -63dB (0.0707%), the third at -80dB (0.01%), a fourth at -86dB (0.005%), and a fifth at -88dB (0.0039%).

Figure 1. Total harmonic distortion (THD) at 1kHz at an output of 1-watt into an 8-ohm non-inductive load, referenced to 0dB. [Lindemann MusicBook:55 Power Amplifier]

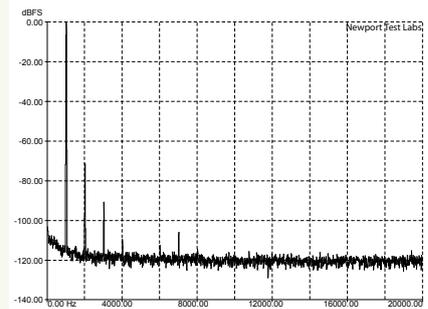


Figure 2. Total harmonic distortion (THD) at 1kHz at an output of 1-watt into a 4-ohm non-inductive load, referenced to 0dB. [Lindemann MusicBook:55 Power Amplifier]

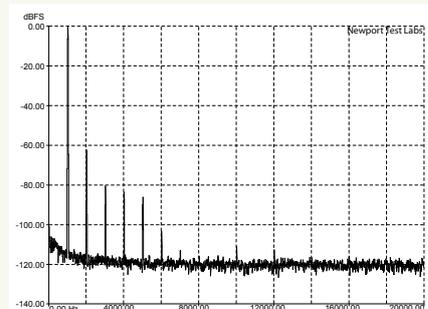


Figure 3. Total harmonic distortion (THD) at 1kHz at an output of 100-watts into an 8-ohm non-inductive load, referenced to 0dB. [Lindemann MusicBook:55 Power Amplifier]

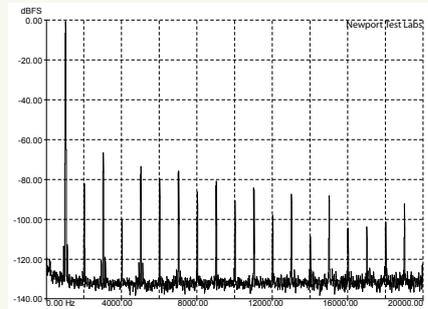


Figure 4. Total harmonic distortion (THD) at 1kHz at an output of 200-watts into a 4-ohm non-inductive load, referenced to 0dB. [Lindemann MusicBook:55 Power Amplifier]

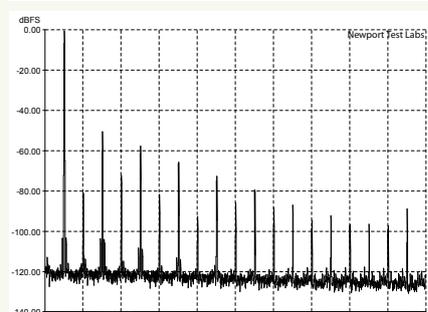


Figure 5. Intermodulation distortion (CCIF-IMD) using test signals at 19kHz and 20kHz, at an output of 1-watt into an 8-ohm non-inductive load, referenced to 0dB. [Lindemann MB:55]

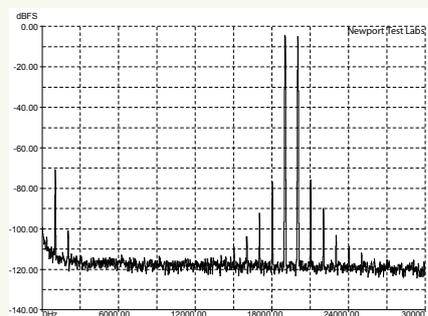
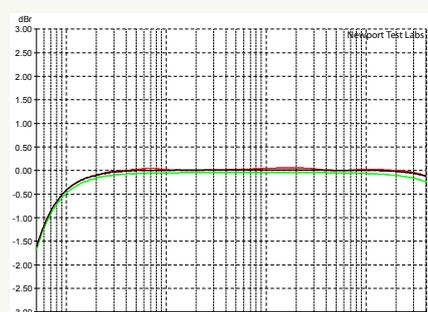


Figure 6. Frequency response of line input at an output of 1-watt into an 8-ohm non-inductive load (black trace), 4-ohm load (green) and into a combination resistive/inductive/capacitive load representative of a typical two-way loudspeaker system (red trace). [Lindemann MB:55]



Newport Test Labs measured the signal to noise ratio at 101dB A-weighted referenced to an output of 100-watts per channel

There are seven higher-order harmonic distortion components visible above the noise floor, but all are more than 100dB (0.001%) down.

Graph 3 shows distortion when the musicbook:55 is driving an 8Ω load at an output of 100-watts per channel. You can see that odd-order harmonics dominate, and that with the exception of the fourth harmonic the first six harmonics all lie between -68dB (0.0398%) and -82dB (0.0079%). When driven into 4Ω loads, at 200-watts output (Graph 4), distortion increases further, again with odd-order harmonics dominating, and with the third

harmonic component now sitting up at -50dB (0.3162%).

Intermodulation distortion is shown in Graph 5, and you can see the unwanted 1kHz difference signal generated by the 19kHz and 20kHz test signals is sitting at -71dB (0.0281%). The sidebands at 18kHz and 21kHz are sitting at around -76dB (0.0158%), while the pair at 17kHz and 22kHz are at -93dB (0.0022%) and -90dB (0.0031%) respectively.

Newport Test Labs measured the signal-to-noise ratio of the musicbook:55 at 81dB A-weighted referenced to an output of one watt, and 101dB A-weighted referenced to 100-watts.

Square wave performance was good, though interpretation is made a little difficult by the presence of the high-frequency switching of the Class-D design (at around 355kHz), which has not been filtered out either by the amplifier itself or by Newport Test Labs.

The 100Hz square wave shows excellent frequency response, extending down to d.c. and a complete lack of phase shift (also excellent). The slight overshoot visible on the leading edge is the result of a rise in the frequency response above 20kHz.

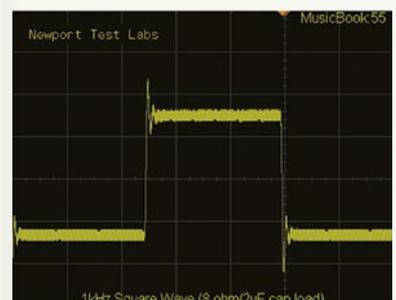
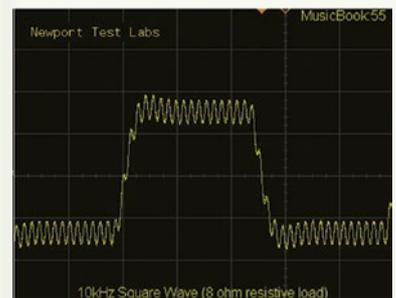
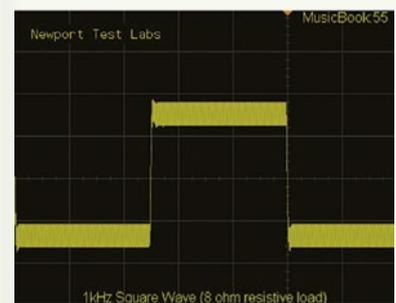
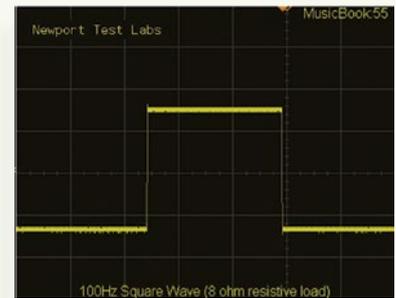
The 1kHz square wave shows this same overshoot, as well as the high-frequency switching noise. The 10kHz wave begins to resolve the noise, but the waveform shows

Lindemann MusicBook:55 – Power Output Test Results

Channel	Load (Ω)	20Hz (watts)	20Hz (dBW)	1kHz (watts)	1kHz (dBW)	10kHz (watts)	10kHz (dBW)
1	8 Ω	111	20.4	110	20.4	110	20.4
2	8 Ω	110	20.4	110	20.4	110	20.4
1	4 Ω	205	23.1	205	23.1	205	23.1
2	4 Ω	205	23.1	205	23.1	205	23.1

Lindemann MusicBook:55 – Laboratory Test Results

Test	Measured Result	Units/Comment
Frequency Response @ 1 watt o/p	<1Hz – 45kHz	-1dB
Frequency Response @ 1 watt o/p	<1Hz – 63kHz	-3dB
Channel Separation (dB)	67dB / 70dB / 61dB	(20Hz / 1kHz / 20kHz)
Channel Balance	0.045	dB @ 1kHz
Interchannel Phase	0.11 / 0.07 / 1.22	degrees (20Hz / 1kHz / 20kHz)
THD+N	0.023% / 0.181%	@ 1-watt / @ rated output
Signal-to-Noise (unwghted/wghted)	79dB / 81dB	dB referred to 1-watt output
Signal-to-Noise (unwghted/wghted)	100dB / 101dB	dB referred to 100-watts output
Input Sensitivity (Balanced)	118mV / 1.15V	(1-watt / 100-watts output)
Power Consumption	0.48 / 19.47	watts (Standby / On)
Power Consumption	21.70 / 234	watts at 1-watt / at rated output
Mains Voltage Variation during Test	237 – 243	Minimum – Maximum



significant rounding, reflecting the amplifier's -3dB down-point of 63kHz.

The fourth oscillogram reveals that the musicbook:55 will be completely stable into highly reactive loads.

Overall, the Lindemann's musicbook:55 is an excellent Class-D design, though given the increase in distortion with decreasing impedance combined with the fact that its protection circuit triggered when driving 2Ω loads, I'd recommend using speakers with a nominal impedance of 6Ω or higher. ⚡

Steve Holding

Readers should note that the results mentioned in the report, tabulated in performance charts and/or displayed using graphs and/or photographs should be construed as applying only to the specific sample tested.

