



Sunfire XTEQ 12

SUBWOOFER

Although Sunfire is now owned by CoreBrands, which in turn is owned by Nortek, the Sunfire company and brand was established by none other than Bob Carver, one of the most controversial audio electronics designers in America. *Home Theatre Review* magazine dubbed him “one of the five most influential people in the history of audio” (but regrettably failed to mention the names of the other four!) His claims to fame are many, but include the fact that ‘way back in 1972 he designed what was then the world’s most powerful hi-fi amplifier (the Phase Linear 700); and was responsible for inventing the auto-correlator, the symmetrical charge-coupled detector, the magnetic field coil amplifier, sonic holography, and the tracking down-converter amplifier, one of which is found inside Sunfire’s XTEQ 12 subwoofer.

THE EQUIPMENT

It is the use of a tracking down-converter amplifier that enables the Sunfire to bestow the XTEQ 12 with an amplifier power rating of 3,000 watts, far more power than would be possible with a conventional Class-AB amplifier or, quite possibly, a Class-D amplifier. Carver’s tracking down-converter amplifier is a variant of the Class-H amplifier topology.

To understand how Class-H works, you need to understand that in amplifiers that use conventional power supplies, the designer uses a power supply with a voltage high enough to deliver the maximum power of which the amplifier is capable. So, for example, if the amplifier were to be rated at 100-watts per channel into 4Ω, the power supply would need to deliver 20 volts ($P=V^2/R$ so $50 = 400/4$). The problem is that when the amplifier is not operating at its

maximum output, and instead is delivering, say, only 1-watt, which requires only 2 volts, the power supply will still be delivering 20 volts, so the remaining 18-volts is turned into heat, rather than sound, and thus effectively wasted. This isn’t a problem with low-powered amplifiers, but as power output increases, the cost of building power supplies becomes prohibitive, and it also becomes expensive to remove the heat (by means of heatsinks and/or fan-cooling).

In Class-H designs the voltage of the power supply is varied depending on the power output required at any given moment, so that if you’re playing at 1-watt, it would supply only 2-volts, since this is all that’s required. If you turned the volume up to 4-watts, the power supply voltage would increase to 4-volts. At an output of 50-watts, the power supply would deliver the full 20-volts.

This means there's nothing wasted, therefore almost no heat—and so no need for heatsinks and fans—but it also means that the power supply can be made relatively cheaply.

The difficulty in designing Class-H designs lies in the designer ensuring that the power supply is always 'one step ahead' of the output stage, so that it's always ready to deliver the full voltage required, and Carver's tracking down-converter was an innovative way of doing this inexpensively and with very few components... indeed it was sufficiently innovative that he was awarded a patent for it—US Patent 4,484,150. (Incidentally, Carver's own patent application cites more than thirty previous patents where inventors were trying similar approaches to the problem, so he was well aware that he didn't 'invent' Class-H, but he did invent a unique and very practical implementation of it, and one that's been so successful that it's still being used thirty-five years later—a point Carver's critics conveniently seem to overlook.)

All of which rather begs the question of why you'd want a 3,000-watt amplifier inside a subwoofer anyway. The answer to that is partly physics and partly marketing. In order to extract maximum performance (that is, good low-frequency extension, low distortion, and high volume levels) from a subwoofer, you need a large enclosure. The problem is that very few consumers want a large enclosure in their living space. So manufacturers build enclosures that are smaller than optimum, and whenever they do this, they have to settle for either reduced low-frequency extension, increased distortion, or lower volume levels: in other words, 'something's gotta give!'

However, there is one work-around to the getting bass out of a small cabinet conundrum, and it's one that hinges around the fact that the only reason the volume drops off is that when a cone is mounted in a small enclosure, the amplifier has to work harder to push that cone, which requires more power... lots more power. In the past, it was simply not practical to include a sufficiently high-powered amplifier in small subwoofers—they simply cost too much to build. But Carver's tracking down-converter amplifier broke the rules: it could deliver enormous amounts of power very cost-effectively, and it was this that enabled Sunfire to build such small subwoofers... and this new Sunfire XTEQ 12 is certainly small, indeed at 330×330×310mm I would normally have called the XTEQ 12 a 'tiny' subwoofer, except that I can't do that because the two other models in the XTEQ range are even smaller.

As with all things Sunfire, the model numbers actually mean something. The 'XT' stands for eXtended Throw, because the roll-surrounds fitted to the drivers in these

models have Sunfire's so-called 'Asymmetrical Cardioid Surround' geometry, which the company says: 'enables them to travel over a very long throw without distorting.' The 'EQ' stands for Equalisation, except that in this case, the equalisation is automated. Each subwoofer comes with its own microphone and has a signal generator and measurement circuitry built in that can be used to measure the output of the subwoofer in your room, after which it can then automatically adjust the frequency response of the subwoofer for best performance in that room. It does this at four frequencies: 35Hz, 49Hz, 64Hz and 84Hz. (And if, for any reason, you don't like the result of the automated circuitry, you can over-ride it, and instead set the equalisation 'by ear'.)

As for the final numbers in the model name, that's good ol' imperial inches, showing that the XTEQ 12 has a 12 inch (305mm) diameter bass driver. And yes, that's driver singular... there is only the one driver, and it's on the left side of the subwoofer as you're looking at it from the front. The circular thing that *looks* like a driver on the opposite side to the woofer (that is, on the right side of the subwoofer as you're looking at it from the front) is actually a passive radiator—that is, although it has a cone and suspension, there is no voice coil and no magnet. The passive radiator's motion is created entirely from it moving in and out in response to differences in air pressure inside the cabinet created by the movement of the bass driver: which is the reason some people call passive radiators 'drone cones' (but they're also known as auxiliary bass radiators, or ABRs). Whatever you decide to call it, Sunfire is at least honest enough to point out that it is a passive radiator. Some manufacturers don't mention this at all, presumably hoping you'll think you're getting multiple drivers.

Although you can't see it, the magnet fitted to the bass driver inside the XTEQ 12 is absolutely massive: 190mm in diameter and 90mm deep, it weighs 5.5kg. This magnet is essential to the operation of the XTEQ 12 because if you were to use a 3,000-watt amplifier to drive a conventional bass driver, with a small magnet and a large voice coil, you'd simply burn out the voice coil. Sunfire's use of a high-power amplifier plus a high back-emf driver ensures the voice coil never 'stalls' in the gap.

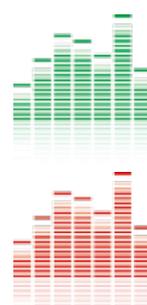
The rear panel of the Sunfire XTEQ 12 has both unbalanced (via RCA) and balanced (via XLR) inputs as well as two line-level outputs. The line-level outputs can be a simple pass-through (unaffected by any of the subwoofer's settings) or high-passed through an 85Hz high-pass filter, using a switch located between the left and right output terminals.

There are also 'Slave Input' and 'Slave Output' terminals, which allow you to link multiple XTEQ 12 subwoofers together. By using the 'Slave' links to do this, all the settings you make on the 'Master' subwoofer will be replicated on the 'Slave' subwoofers, which greatly simplifies operation if you are using two or more subwoofers. Using dual subwoofers is a classic way to solve issues you may have with room modes, plus it's also an easy, efficient and cost-effective way of increasing bass levels in larger rooms.

A rotary control is used to adjust crossover frequency, and is adjustable from 30Hz to 100Hz. The phase control—also rotary—is continuously adjustable between 0° and 180°. The level control is rotary, with calibration markings only for 'Min', '0dB' and 'Max'. There are several fittings for use with the automatic equalisation circuitry, including an EQ LED, a 'Start' button, an EQ on/off switch and a microphone input.

SUNFIRE XTEQ 12 SUBWOOFER

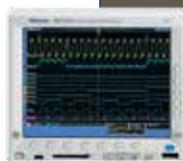
Brand: Sunfire
Model: XTEQ 12
Category: Powered Subwoofer
RRP: \$3,199
Warranty: Two Years
Distributor: Qualifi Pty Ltd
Address: 24 Lionel Road
 Mt Waverley VIC 3149
 ☎ **1800 242 426**
 ☎ **(03) 8542 1111**
 ✉ **info@qualifi.com.au**
 🌐 **www.qualifi.com.au**



- Tiny size
- Automated calibration
- Massive bass
- Loudness

LAB REPORT

Readers interested in a full technical appraisal of the performance of the Sunfire XTEQ Subwoofer should continue on and read the LABORATORY REPORT published on page 114. 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.



Lab Report on page 114

The other controls are a 12V d.c. trigger for remote power switching, a power LED and a mains power switch. Although the mains power switch has only two positions (off and on) the XTEQ 12 is fitted with a signal-sensing circuit that will turn the subwoofer off after a period in which it does not detect an audio signal. If you then apply an audio signal, it will switch on automatically. I prefer three-position power switches (Off, On, Auto) but for no particular reason... it's just an idiosyncratic personal preference.

Unpacking Sunfire's XTEQ12 was like playing pass the parcel at a child's birthday party. First you open the carton, and take out the carton inside. Then you open that carton and take out the carton inside that one. Then you open that carton and take out what looks to be another carton... but is actually a small insert containing the grilles, cables and other accessories, underneath which is... finally... the subwoofer itself. I mention this only because it seemed so unnecessary and wasteful. Maybe if Sunfire spent as much time on the design of its packaging as it does on the design of its subwoofers... but one reason for the packaging is simply that despite its size, the XTE Q12 weighs more than subwoofers four times its size: 26.8kg. (I had to get someone to help me lift it out of the box!)

IN USE AND PERFORMANCE

When it comes to getting the ultimate performance from a subwoofer—any subwoofer—you need to follow the same three rules any real estate agent would give you when you're house-hunting: position, position and position. You need to spend considerable time making sure that you position a subwoofer in the optimum position (acoustically speaking) in your room before you do anything else at all. Sunfire's XTEQ 12 manual gives excellent advice on how you should go about working out the best position for it, so I'd recommend you follow this advice. However, if you'd like more detailed information on installation, you can find it here: www.tinyurl.com/subwooferplacement

As I have made clear on previous occasions, the 'best' positions in my main listening room are also positions to which my better half objects on account of them being too visually intrusive, with the result that my own (very large) subwoofer is usually in a less-than-optimum position for most of the time, only coming out to the prime location on special occasions. However, whenever I'm reviewing small subwoofers, such as this XTEQ 12, they're so small that they're not visually intrusive, and thus can be slotted into one of the several 'acoustic best' positions available.

Although Sunfire gives some advice on how to set the crossover, volume and phase controls, I was disappointed to find that it no longer includes the extensive and useful information it included with its Atmos series subwoofers.

That advice was actually a calibration procedure recommended by Professor David Rich (reproduced in the Sunfire brochure with his permission), and was truly excellent, but it did require the purchase of both a test CD and a sound pressure level meter. Maybe Prof Rich withdrew his permission, or Sunfire thought that the procedure was too complicated for non-professionals. Either way, it's a pity it's not there. If you're interested in taking a technical approach, I have developed a method that lets you use your mobile phone in conjunction with a low-cost test CD to accurately adjust the settings of the XTEQ 12 (or any other subwoofer) so its output integrates perfectly with the output of your main left and right speakers. All the information you'll need is in the article 'How to Set Subwoofer Controls' that appears on page 96 of this issue of Australian Hi-Fi Magazine and at <http://tinyurl.com/set-subwoofer-controls>

Another thing that has changed (and this time for the better!) is the process required to calibrate the Sunfire XTEQ 12. Sunfire's automatic equalisation circuit has been around for quite some time, but the early iterations required you to read two pages of detailed instructions, which you then had to follow to the letter and, if you made a mistake, you had to go all the way back to the beginning, plus the process wasn't actually automatic at all—it required lots of button pushing, along with some serious critical listening. I am overjoyed to be able to report that the calibration system is now completely automated. You simply position the microphone in the listening position, press the 'EQ Start' button and wait for the blue light to turn off (around 15–18 seconds). I started off my listening session by pulling out my biggest gun, my recording of Jean Guillou playing 'The Great Organ of St Eustache' in Paris (Dorian DOR-90134) which contains thundering organ works from Bach (of course), Mozart, Charles-Marie Widor, Liszt, and Guillou himself, whose works make use of the organ's ability to go down to 6Hz. Although St Eustache was chosen by Berlioz for the first performances of *Te Deum*, as well as his *Requiem*, and was also the site of the first performance of Liszt's *Masse de Gran*, the organ that's in the church now was not used for those performances. The present 'Great Organ' (aptly named, because it has 101 stops which operate 8,000 pipes) was built by Dutch organ builders van den Heuvel. I only had to listen to the first track on this disc, Bach's famous *Tocatta and Fugue in D Minor* (BWV 565), to confirm that the Sunfire XTEQ 12 is capable of delivering the lowest notes you're ever going to hear (or feel) from CD or DVD—or hi-res file—and is able to do so at a volume level that, coming from such a small subwoofer, I found absolutely astounding. But I did listen through the entire disc, because the lowest notes don't come until the third and fourth movements of Guillou's 'The Rhetoric of Fire' and the very last track (Liszt's *Fantasy and Fugue on the name B.A.C.H.*).

And remember that the lowest notes, even on a conventional pipe organ, are so low that you don't hear them as such, but instead physically 'feel' the movement of air in the room (plus you'll usually also hear rattles as the air movement actually vibrates objects in the room).

Since it was time for my weekly ritual playing of 'Dark Side of the Moon', a disc that also has some of the lowest notes recorded on a commercial 'rock' CD (the famous 'heart-beat' that kicks off *Speak To Me/Breathe* has most of its energy centred at 27Hz, just half a hertz lower than the lowest note on a standard piano keyboard), this was the disc I played next.

I turned the volume up high before I started to make sure I didn't miss the very first heart-beats, which are recorded at a very low level, and I certainly heard them perfectly, but was shortly after running over to my system to turn the volume down, such were the levels that were being reproduced. I can't say it was the loudest subwoofer I've ever heard on this track, but I was certainly impressed, and I can say that I haven't heard any other sub of the same size that was able to come within coo-ee of the XTEQ 12's performance on this track... or, indeed on the entire CD. So it would appear that to some extent, Sunfire has prioritized deep bass performance over volume level, though I think the XTEQ 12 will be plenty loud enough for most users.

Although pipe organs (and synthesisers) can play down to 6Hz, and piano keyboards down to 27.5Hz, very few other instruments get anywhere near this low, so most of the bass you hear when listening to music lies above 30Hz and below 100Hz, and so it's in this 30–100Hz region where you want a subwoofer to deliver its best performance, and the Sunfire XTEQ 12 *does* deliver its best performance over this frequency range—indeed I think its performance over this range is so good that it must have been specifically optimised for it.

This means that your main speakers will need to have a frequency response that extends down to around 80Hz in order to integrate properly with it... which is hardly a big ask, since most loudspeakers will be able to do this quite easily—it's only the tiniest bookshelf speakers that won't.

CONCLUSION

Three years ago I reviewed Sunfire's tiny Atmos subwoofer, and its performance was so amazing (jaw-droppingly good, according to that review) it should really have prepared me for the performance of this new (and only slightly larger) Sunfire XTEQ 12 subwoofer. But despite my prior experience with Sunfire's technology, the XTEQ 12 still managed to surprise me with its size, its performance for that size, the accuracy of its automated calibration circuitry and the simplicity of that circuitry's operation.

If it's a small subwoofer you're after, you need look no further!  *greg borrowman*

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LABORATORY TEST RESULTS

You don't need to go past Figure 1 to see that Sunfire's automatic equaliser works a treat! In fact Figure 1 shows that it's very smart indeed. The top (black) trace shows the in-room frequency response of the XTEQ 12 after the auto-equalisation and you can see the response is almost ruler-flat between 30Hz and 70Hz, and only 6dB down at 18Hz and 150Hz, which means, normalised, Newport Test Labs measured the Sunfire XTEQ 12's frequency response as 18Hz to 150Hz ± 3 dB. That's impressive. As for the equalisation circuit being smart, that's demonstrated by the lower (red) trace which shows the response with the crossover set to 30Hz. In this case, the Sunfire XTEQ's frequency response is very flat from around 18Hz up to 35Hz, after which it rolls off at around 8dB per octave.

Figure 2 shows the near-field unequalised sine responses for the bass driver for four settings of the crossover control. It would appear that there's no difference between the 100Hz and Bypass settings.

The slight 'squiggle' on the 30Hz trace is where some mains hum has crept into the test set-up and should be ignored. You can see the output of the driver peaks at around 66Hz when the crossover is at the 100Hz setting and at 55Hz when it's at the 65Hz setting. The driver's minimum output is down at around 27Hz, but this is where the output of

the auxiliary bass radiator (ABR) kicks in, as you can see in Figure 3, where the frequency response of the ABR is shown as the trace with the dashed lines. It appears that Sunfire has tuned the ABR a little lower in frequency than the textbook suggests, in order to gain some additional 'free' bass extension.

The two traces in Figure 4 are in-room pink noise frequency responses, smoothed to one-third octave, with the top-most one showing the raw unequalised response of the Sunfire XTEQ 12, and the bottom one showing the equalised response (as is also shown in Figure 1). You can see that below 30Hz and above 100Hz the traces are almost identical, so the auto-equalisation circuit has simply pulled down the gain in each of the four bands to flatten the response.

The Sunfire XTEQ 12 performed exactly as claimed by its manufacturer and provides an extremely flat frequency response across its passband for all settings of the crossover control.

Steve Holding

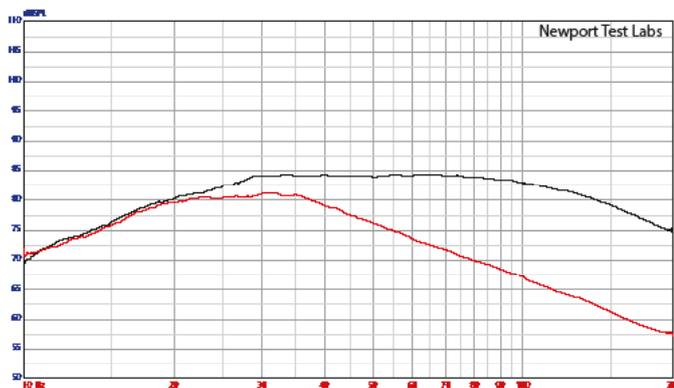


Figure 1: Pink noise frequency responses (smoothed) at 2.0 metres with crossover control at minimum (30Hz) and maximum (100Hz) after auto-equalisation. [Sunfire XTEQ 12]

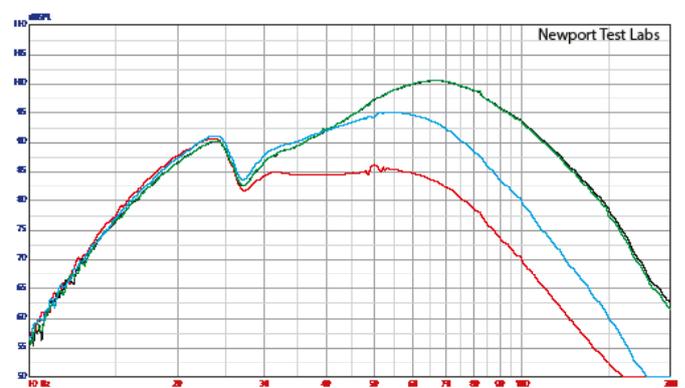


Figure 2: Nearfield sine frequency response of bass driver with crossover control set to 30Hz (red trace), 65Hz 'Normal' (light blue trace), 100Hz (green trace) and Bypass (black trace), with auto-equalisation circuitry disabled. [Sunfire XTEQ 12 Subwoofer]

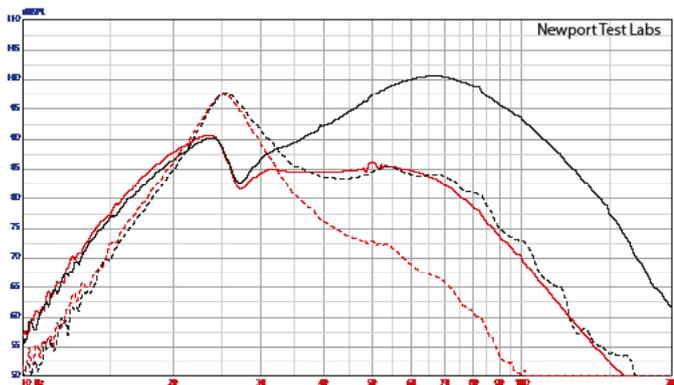


Figure 3: Nearfield sine frequency response of bass driver and part with crossover control set to 30Hz and 100Hz, with auto-equalisation disabled. [Sunfire XTEQ 12 Subwoofer]

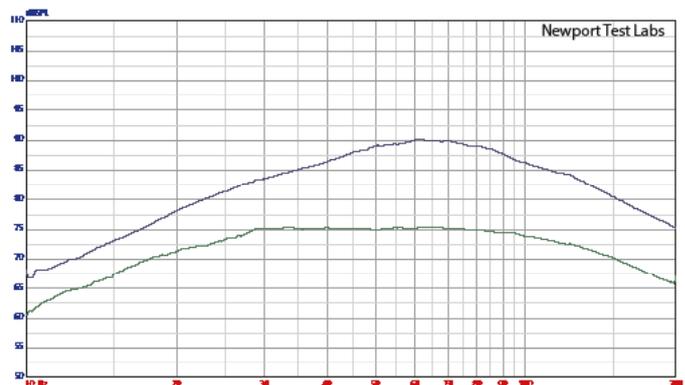


Figure 4: Pink noise frequency responses (smoothed) at 2.0 metres with crossover control at 100Hz, showing response with equalisation (black trace) and with auto-equalisation circuit disabled (green trace). [Sunfire XTEQ 12 Subwoofer]

