

Electric Sound Development

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Changes

One of the most enjoyable parts of this hobby is that it is changing and developing so fast. The ability now exists for a scale enthusiast to add the true engine sound to a plane, and it is now getting easier. In fact, it could be suggested that QEFI soon reverts to EFI, as there are times when these electric models may not be so quiet!

Since my last article was published in QEFI in the October 2005 issue, there have been developments and improvements on the sound circuitry and output. It is now becoming lighter, louder and much cheaper, so it is time to bring you up to date.

In 2005 the ability to reliably broadcast genuine engine sound in an R/C plane was achieved and the trusty HE111 had over 30 trouble-free flights with the sound unit blasting away. On the HE111 the sound system uses a separate 12 v power supply to drive the two 20 W amplifiers. The digital engine sound file is controlled by the Benedini TSB4 sound circuit. A 700 mAh 10-cell NiMH 12 v battery pack powers the sound for about 14 minutes, so there is more than enough for a full flight.

The sophisticated Benedini sound card actually has the true engine recorded sound files pre-programmed in the software, and it is controlled by plugging it into the throttle speed controller lead in a daisy chain connection. This means that the engine sound 'speed' is proportional to the throttle position and it will follow up the speed of the actual electric drive motor(s).

A separate servo is used to switch on the electronics and also trigger the sound of the engine starting, while it coughs and pops into the tick-over mode. It is here that the throttle stick is eased forwards to coordinate the prop starting to rotate. One can then taxi out, take-off and fly. The sound will be exactly as the full size plane.

Special sounds can also be recorded and recovered via another receiver channel operating a small servo. On the HE111 the machine gun sound is good if ever an attacking Spitfire should get too close!

After landing and taxiing back, the stop/start control is again triggered as the true sound of the engine stopping will be emitted. It is here that the throttle stick is brought full back and a convincing shutdown procedure is then completed.

This opto-isolated electronic TSB4 wizardry is contained in a circuit about 65 mm square and

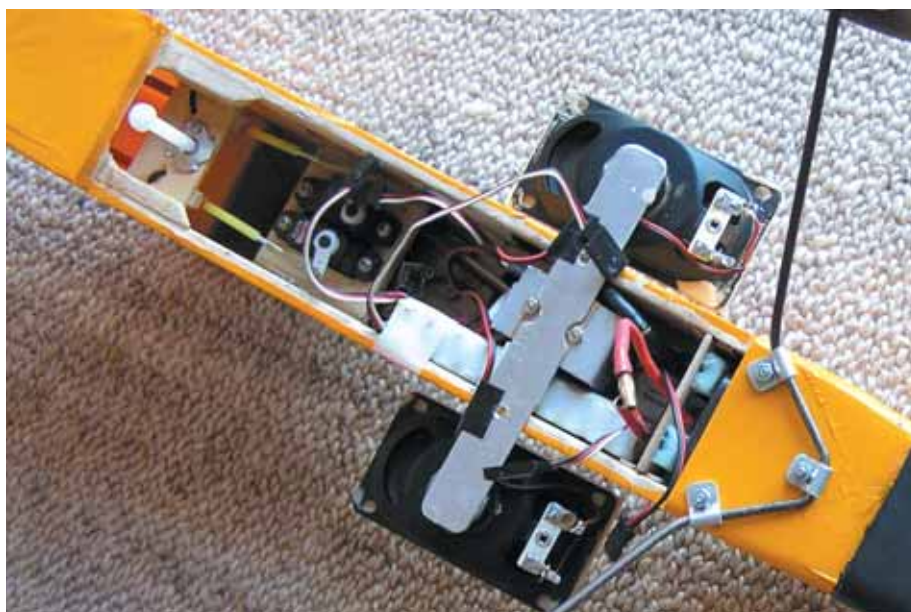
Realistic sound is now feasible in more models.



▲ 89 mm Blaupunkt speaker with tweeter. It is hoped to get down to this weight for smaller models



▲ 100 mm Visaton Speaker, it is difficult to beat this one.



▲ 'Heap of the Week' is tasked to test the Micro first with small speakers and 12 v 110mah batteries



▲ The Beaufighter testbed (photo by Graeme Macfarlane)

feeds two 20 W (peak) 10 W rms amplifiers. Each amplifier feeds a 4" diameter 4 ohm Visaton R10 S speaker mounted in the wing.

The total weight of this sound unit in the HE111 is about 0.5 kg (17 oz). Each speaker weighs about 150 g, each amplifier weighs about 30 g, the TSB4 sound controller weighs about 20 g plus two miniature controlling servos and one battery of 150 g.

The cost of the TSB4 or now the improved TSB5 unit (with separate plugs and sockets and tone controls) from Thomas Benedini at www.benedini.de is €210 Euros.

So What is New?

Thomas has been developing a new cheaper Microcircuit that can be triggered from only one additional channel. In fact it can even be ordered to not even require that one extra channel if you choose. It is so small that it is dwarfed by the servo leads that now plug

onto the circuit. It has now gone down in size from 65 mm square (TSB4/5) to 12 mm x 25 mm and costs much less at only €79 Euros. It does not have quite so many facilities as the TSB5, but it looks eminently suitable for R/C plane use.

It cannot now play a 'special sound' on top of the main engine sound, but the ear does not really notice this when, for instance, a gun is firing. It also does not have the opto-isolation components between the sound unit and the receiver, so I needed to check this out carefully.

Although this Micro unit also has its own 1 watt amplifier built onto the same miniature circuit, Thomas has also developed a new single 2 x 40 watt (peak) amplifier for those of us who are using them for planes. Over many emails backwards and forwards to Thomas we have been trying to find more powerful versions of the two 20 W peak (10 W rms) amplifiers that are used in the HE111. Thomas has now developed his own two-channel amplifier, which powers two speakers at 40 W (peak) per channel. It is smaller, lighter and not expensive at €39 Euros.

Test and Try Before You Fly

Over the winter Thomas sent me a Micro and new amplifier and it was initially tested on the bench.

The Micro sound circuit is now powered from the receiver supply and will work on its own, with no separate power supply. However, the amplifier requires its own power supply and this can vary between 12-18 v. With a bench type regulated mains power supply, it was fed a varying voltage between 12 to over 15 volts and the sound output obviously went up with the increasing voltage. The sound output from this amplifier is better than the combined total of the two other amplifiers as fitted in the HE111, and the current draw at 15 v can exceed 3 amps.



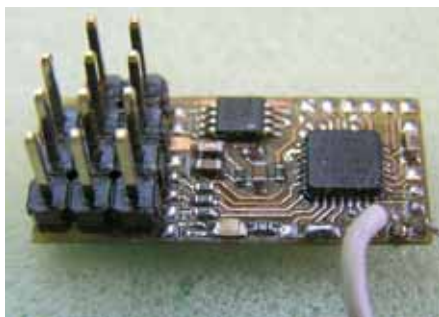
▲ Carving holes in the Beaufighter

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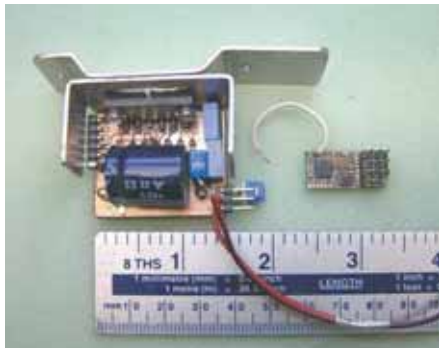
I emailed Thomas and asked him if I could push it to its limits and he advised me to add a variable resistor in-between the Micro and the amplifier. It got louder and louder until one of the R10s speakers burnt out! We now know where the weak link is, and it is not the amplifier.



▲ 'Heap of the Week' test



▲ Micro circuit



▲ New 2x40w amplifier and Micro sound circuit



▲ Speaker test rig Blaupunkt v Visaton

This amplifier does need a heat sink, but one was made with some thin aluminium sheet and it does appear to be adequate, even if it is not necessarily in the cooling air stream. The amplifier chip will shut itself down if the temperature gets too much, so it is fully protected.

Connecting the Micro

A special 'Y' lead is made to connect the receiver to speed controller lead to the Micro unit as well. Additionally a socket-to-socket servo lead is taken from the micro to an auxiliary receiver channel. With a combination of the throttle stick position and auxiliary switch (or dial) position, the sound can be programmed and coordinated to the motor rpm for tick-over and full speed.

Thomas had some early development problems with this first unit and it would not give out special sounds, but as it had passed its first test on the bench, it was time to install it in a model.



▲ Take your pick



▲ Pete Nicholson's Corsair with the two speakers neatly installed beneath the cowl. The amplifier is well cooled in the air stream

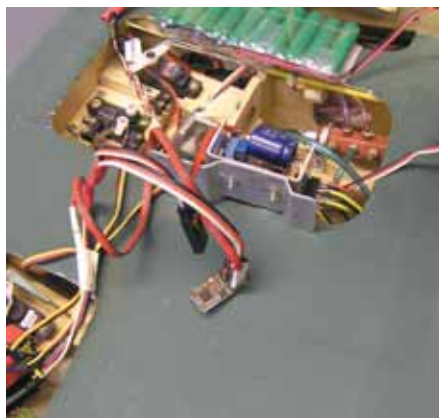
Because this Micro unit does not have opto-isolation I was initially cautious and did not feel inclined to risk fitting it to the old faithful HE111. Therefore, it was put into the local club trainer 'Heap of the Week' to see if it suffered from interference. The plane already had a PPM receiver and although it was not capable of lifting the heavy battery pack and speakers, smaller ones were used for the test. No ferrite ring was fitted.

The ground range check was fine so it was off onto the wide blue yonder to see what happened. Well nothing happened actually, it was fine. No interference was encountered, even on a PPM receiver. 'Heap of the Week' struggled to get as high and as far away as possible and in the five minute flight there were no problems. It was glad to be back on the ground as it was so overloaded, and it flopped back to terra firma obviously exhausted!

Flying Trials

So there was nothing for it but to install the new Microcircuit and 2 x 40 W amplifier into the HE111 and see if it performed in that model as well. This time it was used to power the two 4" speakers and of course the 12 v 700 mAh NiMH power pack was reused. The amplifier was going to be working flat out and the combination again flew with no interference at all. A second long 10 minute flight in absolutely still conditions confirmed that there were no glitches, so the Benedini circuits had some more ticks in the boxes.

The additional sound from the more powerful amplifier does now make an appreciable difference, to the point where a club member said that that was as far as one would comfortably want to go with sound without becoming a nuisance. I agree that it is about right now.



▲ The Micro and new amp in the HE111 ready for the test with spaghetti everywhere. Note the 'power on' LED on the Micro circuit



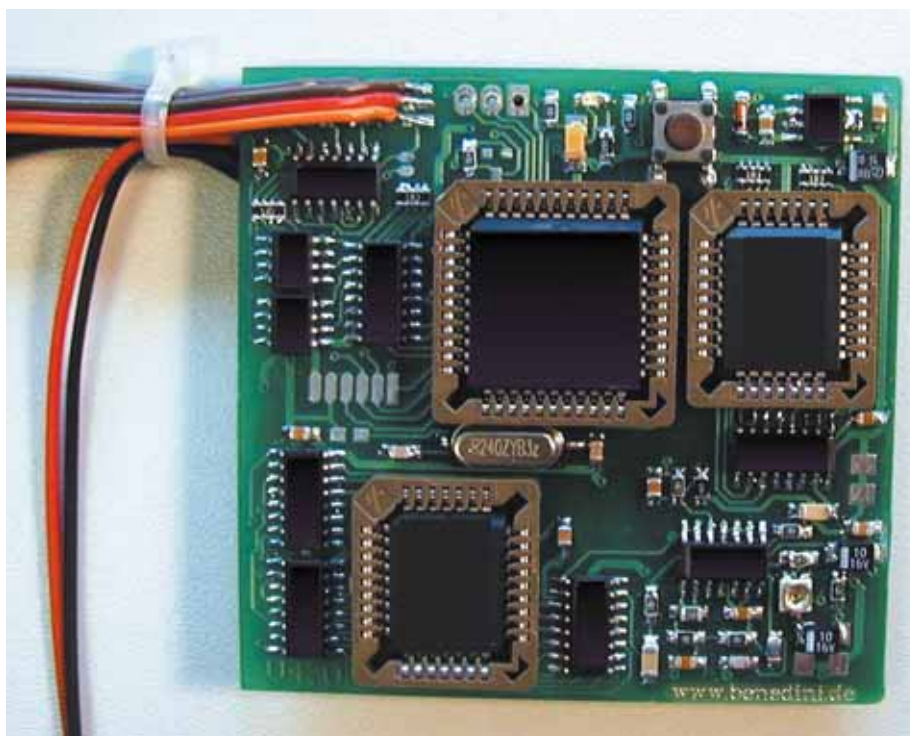
▲ The new TSB4 Micro circuit. All that information held in a circuit the size of a servo connector socket



▲ The sound transmits well when it comes from the underside of the wing, the large cavity acts as a sound box

Pete Nicholson then became interested in electric sound and modified his Hangar 9 Corsair to accept two Visaton R10s speakers in the cowl. We later fitted the amplifier and the development Micro sound circuit into the cowl. Power for the amplifier was from a separate 3S 1500 mAh LiPo pack. Even a piece of lead (ugh) was added to the tail to correct the C of G and the all up weight had grown by over 1¼ lb. We also fitted a ferrite ring to the receiver throttle lead for interference protection. I seldom fly without one to the speed controller now.

After exhaustive ground testing, Pete



▲ This is the larger and more capable TSB4 Benedini sound circuit

powered it into the air without any problems. It was a dark winter's day and in the back straight, for me, in the mist that model became the full size. It was like being at an air show with the growl of the engine giving it tremendous presence. When you cannot see that it is a model and you cannot hear that it is a model then the realism factor takes a jump. This is what we have been striving for in our scale models, and with that I knew I had to try to modify the ME109 as well as the Beaufighter.

Weight Watching

From that Corsair trial it was obvious that the sound unit is suitable for smaller models but that more attention was needed to try to reduce the weight.

The electronics are effectively sorted as far as weight and power output are concerned, so it was back to alternative speaker hunting. It was suggested that the Blaupunkt ODx range may be better as they use neodymium magnets instead of ferrite. The ODx 92 speaker is smaller at 89 mm diameter and theoretically can handle an extra 50% power at 30 W rms. It weighs about the same as the Visaton R10s so it may be possible that we can get away with only one speaker for the necessary sound output.

Although the Blaupunkt speakers are about £35 each rather than about £5 each, a pair were purchased and set up beside two Visaton speakers in a test rig. (See pic).

The Micro and the new amp were wired to drive the two types and sound output was measured. There was a great deal of mickey taking from other club members who were aware that I had just asked for the club noise meter. Threats of the model requiring a noise test certificate were rebuffed, and at least a volume control is a lot easier to manage than fitting a silencer!



▲ This is a mighty amplifier but it does need the cooling fins to dissipate the heat

It was found that two Visaton speakers produced 99 dBA at 1 m, and one speaker on its own gave out 96 dBA. That confirmed the theory that the logarithmic sound increase requires a doubling of sound power to raise the sound level by 3dB. With two speakers at full blast the amplifier was drawing 2.5 A at 12 v from a stabilised bench power supply.

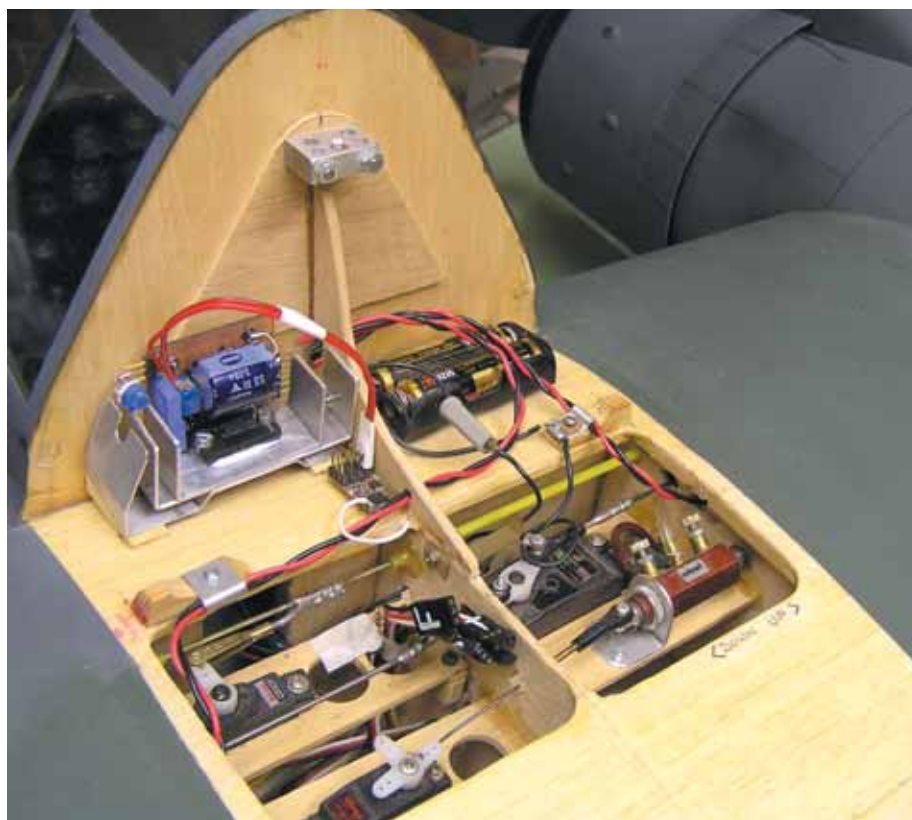
The test rig was set up in the workshop, so it was not in 'free field conditions'. The sound level would be less outside with no echoes from any walls. However, it was a good comparison test to compare the differences between the speakers.

The two Blaupunkt speakers together only produced 95 dBA together, and for one speaker on its own the output was 92 dBA. Power consumption was slightly higher at 2.7 A @12 v indicating that this smaller speaker is slightly less efficient. This may be because it has a small, inbuilt tweeter, which takes up additional power. However, it has the capability of being driven harder and I have yet to establish if a more powerful amplifier will boost the output of this speaker.

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▲ The set up for large models with two speakers



▲ Trial fit of the amplifier and Micro in the Beaufighter. More cooling fins have been fitted as it is not in the air stream

From the experiment with the amplifier I do know that the Visaton speaker does not have much reserve capability left. By increasing the voltage to 15.5 v and 1.5 A for one Blaupunkt speaker the sound level went up to 97.5 dBa.

If a single Blaupunkt speaker is good enough, then it should be easier to fit in the model and also save about 150 g (6 oz).

Future Developments

Thomas is now working on a 30 watt mono amplifier that will run on up to 30 volts. It should therefore be possible to power the amplifier with a varying voltage up to that maximum 30 v. This could be just the amplifier for the single Blaupunkt speaker. So if your main flight batteries are at 30 v or less, then this might be a way of getting away without a separate sound battery pack at all.

The other way of saving weight is to use a voltage regulator powered from the main battery. The new Benedini 2 x 40 w amplifier can take 12 v-18 v input, so a special voltage regulator could use the main motor power battery and regulate it down to a usable level for the amplifier.

As the Micro unit is powered from the receiver battery at 5 volts, we are not stuck at the 12 v maximum voltage required for the TSB4 sound unit. It just gets better and better!

Thomas Benedini is also now working on a voltage regulator for his amplifier and by the time that this edition is published, there might be some information on his website.

It is anticipated that the additional gross weight to a model could be as low as 500 g (1/2 lb) and that will make it so much more suitable for the smaller models.

Available Sound Files

Thomas is gathering together a series of sound files of various engines. It does take a bit of time, as the requirement for any engine sound file is a decent recording of it starting, stopping and running up to full speed. Single and twin Merlin engines are sorted and Thomas has also produced a R2800 radial sound, which has a very sweet tick-over. He now has the sound file for the Daimler Benz engine that goes in the ME109.

If you do require a particular engine sound then it is best to find one on the net or via a CD. Yes, these CDs do exist and the wife is not impressed when I play her the latest version in the car! To an engineer, some of these sound files are music indeed - in short bursts, in the privacy of your own home you understand.

One day all our scale models could easily have genuine engine sound and what will the petrol heads do then - poor things? Watch this space for further improvements.

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