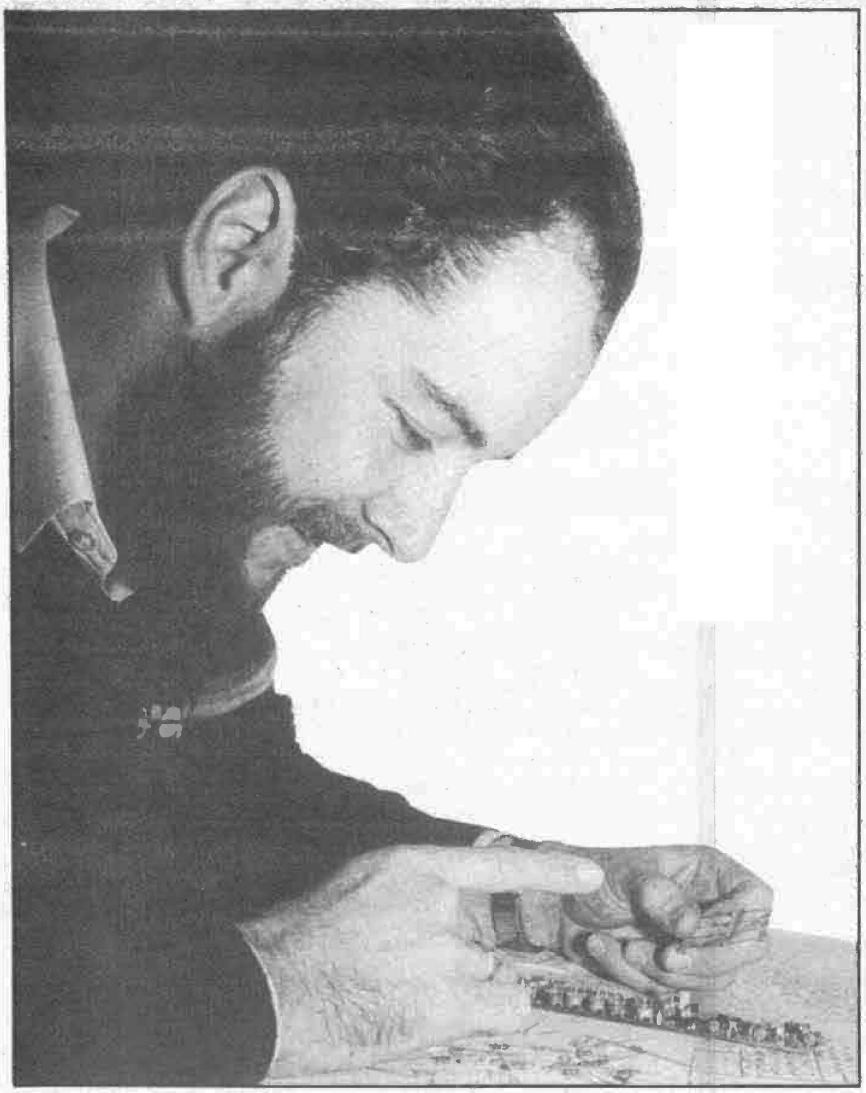


At one stage, it was two in the morning, and we began to run out of film, and brains. Mike tries to decide whether it really is a 47K or whether he needs more coffee.

PARTWORK

How to build a transceiver from a kit – by Chris Drake and friend

Considering that we're jolly keen on the home-brew side of amateur radio here at *Amateur Radio*, we're always keen to have a go at anything that looks as though it's likely to make life easier for the home builder. One company, Wood and Douglas, who advertise in this magazine, do a very interesting range of kits for amateur projects of various sorts and we thought we'd have a look at a typical make-it-yourself job they do in the shape of the 70FM05 UHF receiver and its companion transmitter, the 70FM05 T4.

These are intended for the amateur 432MHz band, and the basic idea is that you can start out with the receiver, the 70FM05 R5 and get that going first; it's crystal controlled, using standard Pye PF1-type crystals which are as common as the proverbial. What you get in the kit is the PCB and the bits to make the heart of the receiver – you put it in whatever case you like, together with things like the S-meter and all the "front panel furniture" (see Shoptalk last issue) you want for your particular application. We reckon this is a great idea because you can make it as fancy or as simple as you like and you'll learn an enormous amount about basic FM receivers as you go.

When you've got the basic board sussed, you can add several things to it. For a start, there's the 70MC06R 6-channel scanner board, so you can scan between channels; we didn't test this but we know a couple of people who use them and like them. Then you can add the 70SY25B synthesiser if you're feeling top of the class with the soldering iron – we'd very much like to test this device since we don't know any other manufacturer who does a DIY synthesiser and if it's as nice as we found the transmitter and receiver to be we reckon it's well worth having.

When you've got the receiver side sorted out to your requirements, you can add the transmitter. We tried the basic 70FM05 T4 for size, although here again you can add the synthesiser if you want to. Having done that you'll end up with a good 70cm FM system that you can honestly say you built yourself – and that can't be bad, can it?

So, what we did was to hand the kit over to the same bod who did the Heathkit test for us, and then the Editor took time out from fretting about getting the magazine together and would-he-get-all-the-copy-in-time to break out the soldering iron.

Here's Mick to tell us what he made of the receiver.

'When the postman dropped a little packet through the door on a recent Saturday morning I was just thinking about getting up and going on the radio, since it was rumoured that there was going to be the aurora to end all auroras.

In fact it didn't happen, so after some tuning around and listening to all the locals being despondent about the lack of DX I decided to have a look at the Wood & Douglas receiver kit. The basic components and a very well made double-sided board fell out of the polythene bag together with an instruction sheet and lots of circuitry and layout drawings. It took a little time before I got the idea but it all looked reasonably straightforward. The PCB is tiny – more like the kind of thing you find in a commercial rig – and the first thing I did was to hunt out my magnifying glass, thinking that I was going to need it before I was through. I did!

"Take care in the actual soldering"

First job was to have a look at the circuitry and get the idea of what was what. It's a single-conversion UHF receiver of more or less conventional design with a nice eight-pole crystal filter and about a watt of audio out. Basically, it was all the electronic gubbins without any cabinet, case or what-have-you, which I thought was nice for those who knew a little bit about how electronic things go together and weren't afraid of chopping holes in diecast boxes and whatnot.

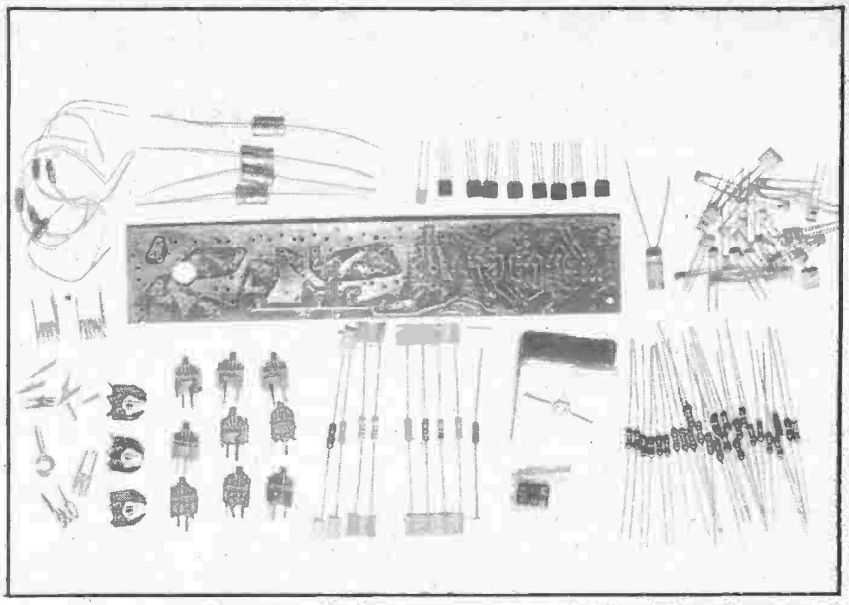
So it was a matter of clearing the kitchen table of the thing I'd been playing with the night before (which was some 10GHz gear which didn't seem to want to work at all well) and lay out all the bits and pieces. Everything was there, and they'd even wound the little coils for you – as far as I could see there was nothing missing and I set to work building.

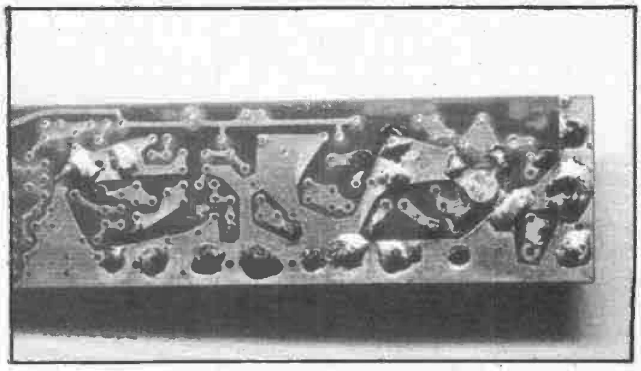
As Wood and Douglas say, this is quite an advanced project for those with little constructional experience, and they're very fair in saying that if you felt you couldn't do justice to the potential quality of the finished product, you could return it to them with the extra cost of a ready-built-and-tested version and they'd supply you with that. Which is nice to know. This kit doesn't strike me as at all tricky provided you take your time and don't guess at things like the colour code for resistors if you're not absolutely sure of what's what.

It's important to take care in the actual soldering as well because, compared with the PCB in the Heathkit meter I built for the last issue, the component density on the board is much higher and it's also double sided – this means that there are connections you need to make and components you need to mount on both sides of the PCB, not just one. So you have to double check that the right bit is going into the right holes in the board, and you'll have to be prepared to keep a close watch on the layout diagrams in order to make sure where you're up to. The board isn't marked with component identification either (unlike the Heathkit), so you need to do that much more work to keep ahead of what you're doing – that isn't a criticism, by the way, because it must cost a fortune to get PCBs silk-screened with component details and it's no more difficult to look after it yourself really.

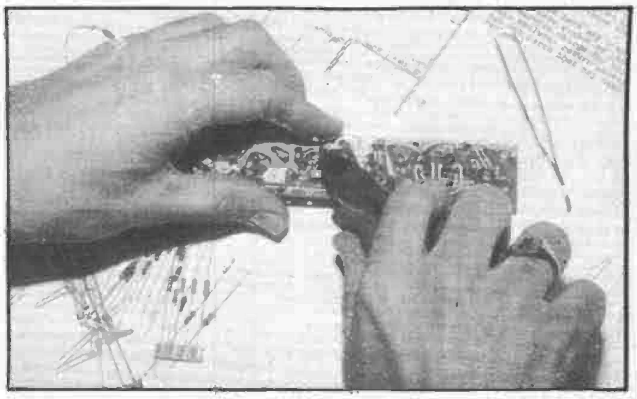
Wood & Douglas provide good instructions for assembly, although they do assume that you know more than the basics – you might not know that "SOT" stands for "select on test" which is what you do when you're not quite sure which component value is going to give you the best results, and so you suck it and see. It's common procedure in the professional world when you're after the best performance from a circuit, and in the case of this receiver it was to do with the type of filter specified.

So it was a matter of blazing away slowly with the soldering iron, stopping for the odd break to give my eyes a rest and to make sure I'd





All the transmitter components laid out – the calm before the storm! Some nice high-quality trimmers were supplied and little ceramic capacitors as well. We suggest you nick the XYL's tweezers before you kick off.



Close-up of the PA transistor soldered on to the PCB. Note the wide leads on the emitter of the transistor to keep the series inductance low.

After the soldering, the cutting. Carefully, so they remain flush with the glass fibre PCB.

got the right transistor or whatever it happened to be. I was impressed with the quality of the components they supplied – they obviously came from reputable sources, and indeed the BFR 91 front-end RF amplifier came from the supplier who's reputed to make the best samples of this device. I got the feeling that whoever designed this receiver had thought about little things like that.

In fact, it was Tuesday evening before I finished it all off, having spent just over 22 hours on it. I'm

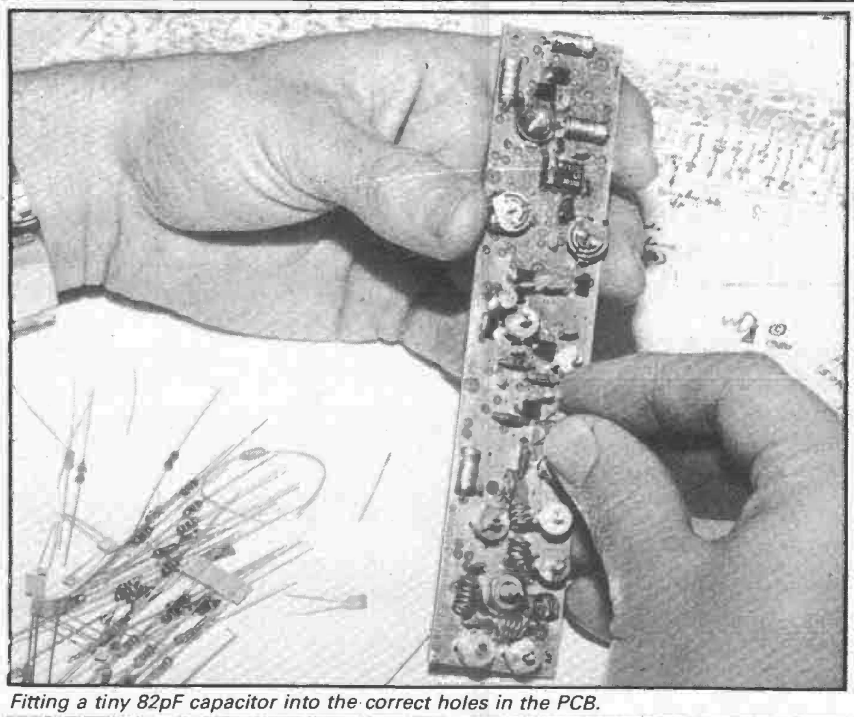
Nice healthy sharsh from the speaker

used to assembling things so I'd imagine that wouldn't be an untypical figure, and I wouldn't be at all surprised if it took many folks a bit longer. Having said that, my eyes aren't what they were 20 years ago, so maybe that slowed me up a bit. Either way, I felt jolly pleased with it when it was done. I didn't have a suitable meter movent handy for the S-meter so I had to improvise with a 60-microamp movement and made a hash of remembering how to calculate the right values to make it into a 200-microamp meter, which slowed me down a bit. However, I did manage to remember the Gospel According to Mr Ohm after some head-scratching and prepared to switch on the 12-volt supply that the thing required. I did remember to bring home from work a couple of suitable crystals, which helped, and I got together all the usual bits of wire and so on that you need to get the thing working.

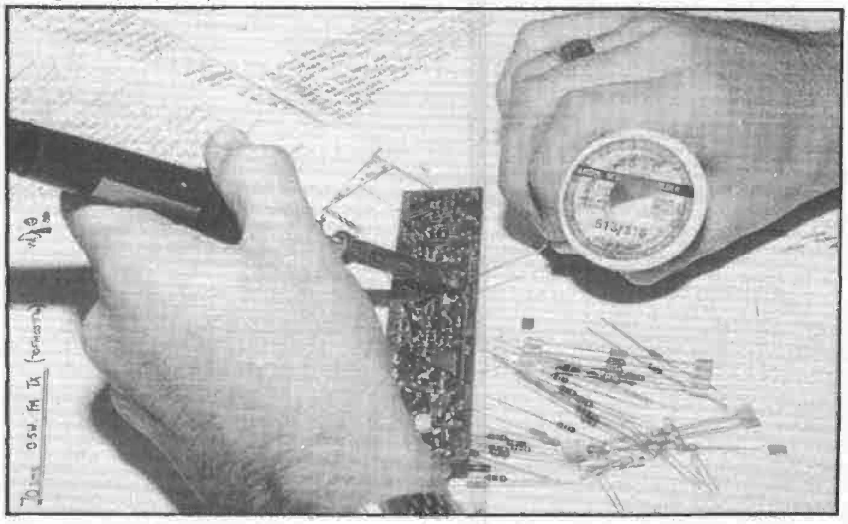
I switched on and – imagine my surprise – it worked. At least, it seemed to be working – all the right currents were where they ought to have been and there was a nice healthy "sharsh" coming out of the speaker I'd hooked up for the occasion. The only snag was that I couldn't hear the signal generator! The crystals I had came out on rather useless frequencies in my area and I didn't have any others, so I was stuck with the generator for the first tests, but when I got the generator delivering its full whack into the front-end of the receiver and I still couldn't hear a tweet, I began to get the message, I'd got something wrong.

Ah well, back to first principles. I applied the genny output to the gate of the mixer MOSFET and wallop! There was the signal, knocking the S-meter needle for six – and what you might call fully quieting and then some. I turned the output down a bit sharpish and wonder what I'd done wrong.

H'mmm – let's have a look at that BFR 91. Surely I couldn't have put it in the wrong way round. Damn it all, I must have used hundreds of the



Fitting a tiny 82pF capacitor into the correct holes in the PCB.



things in my time, and I know perfectly well that they go like this. Er.

Well, we all have our off days. I'd put the thing in the wrong way round. At least I had some solder wick, because desoldering double-sided PCB of this size just isn't funny, but I had my doubts as to whether I had another BFR 91 and surely I'd done this one in?

Actually I hadn't, although I certainly deserved to have. More in hope than anything else, I put it in the right way round and bingo! Everything on line and running, *and* I could hear the generator; even at my age, I still feel like Marconi the first time I get something I've made to work.

Flushed with success, it was time for some measurements. They had to wait until next day because we have a thing called a Sinadder at work and they're just the job for testing FM receivers if you want the best signal-to-noise ratio. In the meantime I sat there with another

Soldering a component into position. Note the fine gauge solder and miniature iron – essential for a build of this sort. It's a good idea to clean the PCB before you begin the job, and to deflux it with propyl alcohol.

coffee listening to the generator and feeling like a clever chap.

Along came lunch hour and it was out with the measuring things. Wood and Douglas specify a sensitivity of better than 0.3 microvolts for 12dB SINAD, but my version was 0.16 microvolts for 12dB, which was good and much better than spec. The next step was to take a look at the noise figure, which came out as a whiff over 3dB. This is good, and is about what I'd expect from a good specimen of a BFR 91 on 432MHz. The squelch worked well, and the squelch tail was about right for an FM receiver – the squelch hysteresis was about 5dB, which seemed good to me although some people might find it a bit high for mobile use when there's a lot of fading – in that case, you can

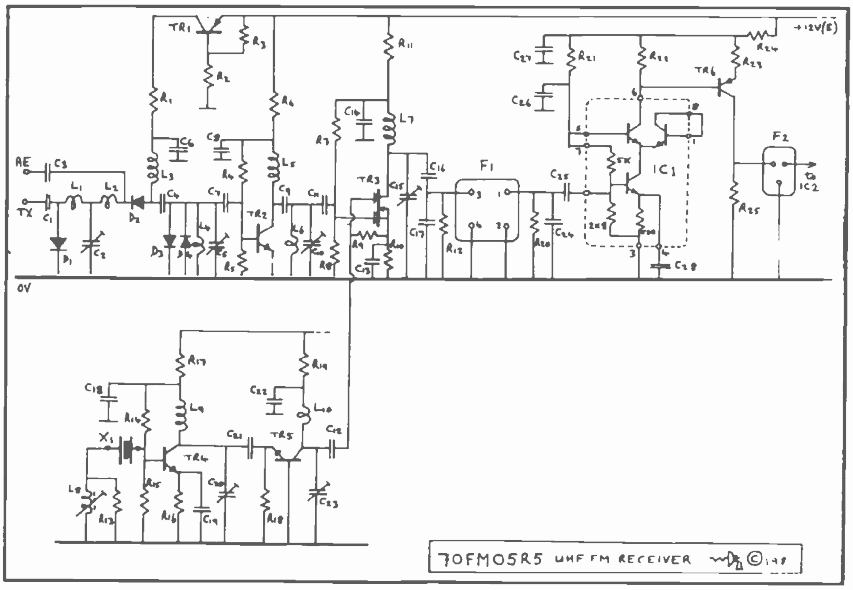


Diagram 70FM05R5 for the UHF FM receiver.

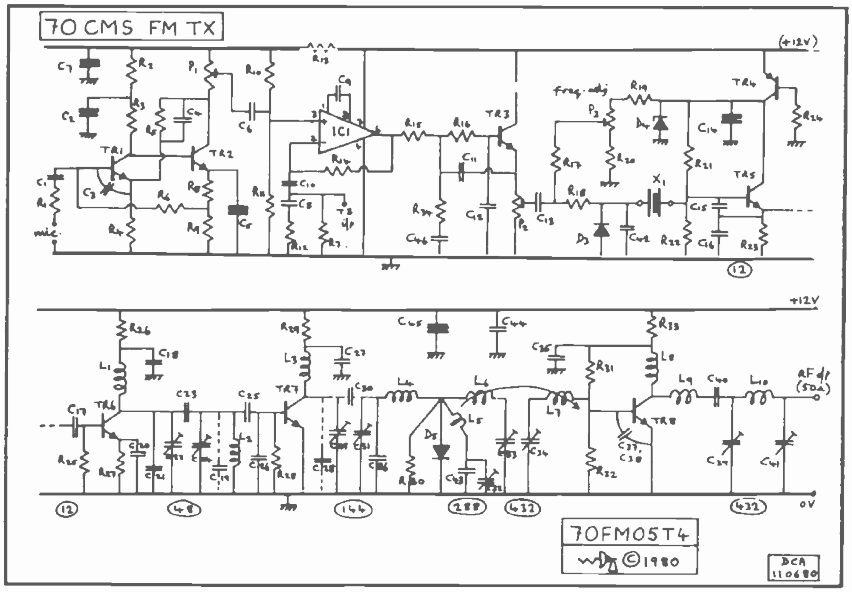


Diagram 70FM05T4. Both drawings are supplied with the build kit.

always take the squelch right out, can't you?

The final step was to get hold of some useful crystals and see how it worked when connected to my antenna. The short answer was "nice", although I got worried when I couldn't hear GB3LW in London. I then remembered that it's been off the air for some time, so another heart attack was averted. GB3NK came storming in, and speech quality sounded good with a nice action on the squelch and enough audio for most applications.

To sum up, I thought this was a superb little receiver. Wood and Douglas deserve to be congratulated for their enterprise in marketing it, and it's certainly dead easy to get it going and to use it. I'd have liked to try out the synthesiser and see how it performed, but if you're in the market for something a bit different from the commercial hand-held rigs, I can certainly recommend this machine.'

ASSEMBLING THE TRANSMITTER

It was down to yours truly to make the transmitter kit, and here again it went together very much like the receiver seemed to. The PCB was even smaller, and I had to pinch an Anglepoise from the Art Editor and assemble the thing with the lamp about two inches from my nose, but it wasn't really any problem. The only thing to be careful of is the output transistor, which needs to go in exactly as Wood and Douglas say it would – I had to fiddle with the cutters to get the lead lengths right for the PCB, and then solder the leads quickly for fear of damaging it. I took about 15 hours to build it, which was a far cry from the two to three hours that Wood and Douglas suggest in their sheet – maybe I'm just slow or something, but that seems like a very short time to make a project of this sort and to make a good job of it, or perhaps I just stopped for too many cups of coffee

Anyway, it was time to test it, and it must have been my lucky day because it worked like a charm. The adjustments and general tweaks were absolutely as per the instructions, and out came just over a watt of RF at the drop of a hat. This was decidedly higher than we expected, but when we got the spectrum analyser out we were delighted to see that the power was all going into the fundamental – the worst sprogs were an output on 144MHz at about −66dB and the next worst was the second harmonic at −78dB. There wasn't anything else worth mentioning, so the next step was to try it out on the air.

The initial reports were that the audio was very bass-heavy and there didn't seem to be enough deviation. We scratched about a bit and bunged an audio generator in to have a look, but we set the dev. up for 4.5kHz at 1kHz input and had another go. Then we read the instructions, especially the bit that said ". . . microphone impedance should be high – low impedance mikes may produce bassy audio". So we took away our low-impedance microphone . . . and scrounged around for a crystal device. This worked well, and indeed the second contact remarked that the audio was now very good indeed! The moral of the story, folks, is read the instructions.

It was now time to put the two together – which we did at about midnight! They're actually very easy to interface, and Wood and Douglas supplied us with their SSR1 solid state relay for the supply switching. This is a little PCB with a few components on it, which we put together in short order – imagine our pleasure when the whole thing worked a treat? We didn't have the time to make a neat job and tidy up all the wires, so the Editor's office looked like the National Physical Laboratory's experimental department by the time we'd done. But it wasn't too late to have a few QSOs via the local repeater – we had to improvise a toneburst, but we had good reports and everything seemed to work just fine.

All in all, then, full marks to Wood and Douglas for their kit – we both thoroughly enjoyed getting them both going, and we must say that there's something about home-brewing that simply can't be beaten. We'd have liked to make ours into a little hand-held, although the current consumption's a bit on the high side for such a use. We'd imagine that you could have the makings of a great base station or a mobile rig if you had a little amplifier hung on to the back of the machinery, and maybe W & D might think about that for their next kit! Anyway, ten out of ten for very nice and well thought out kits.