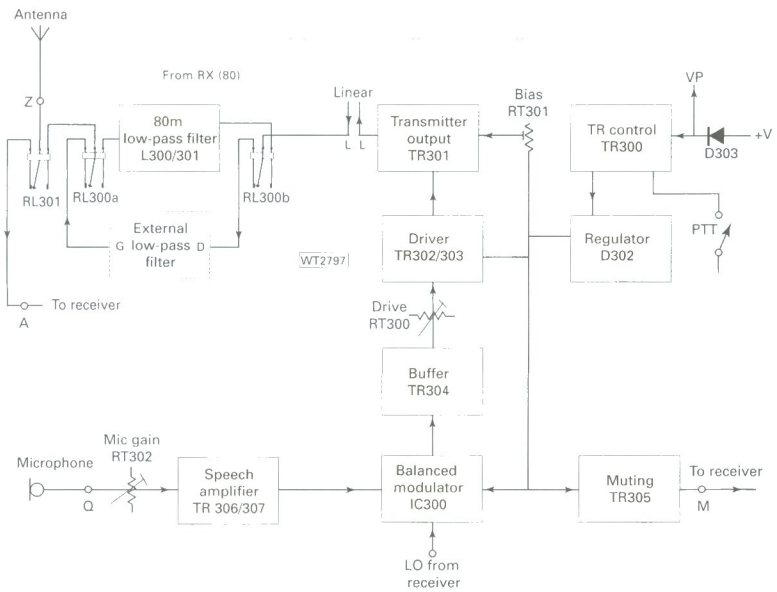
The Sutton Project

The Montis Phone Transmitter

Part 3

This month Tim Walford G3PCJ describes another member of the Sutton family - the Montis transmitter. If you've never tried the double sideband suppressed carrier mode - this could be your introduction!



● **Fig. 1: Block Diagram of Montis transmitter.**

The Montis is a nominal 1.5W phone transmitter that's designed specifically for the Sutton receiver (May 2005 *PW*) so that together they become the Sutton Montis, which is of course the name of yet another village in Somerset!

Its broadband design allows the Montis transceiver operation on all the main h.f. bands when used with the Sutton and its band cards. It produces double sideband (d.s.b.) suppressed carrier 'phone signals that can be read by any station equipped for single sideband with either a superhet, or direct conversion receiver.

Unlike the Mallet c.w. transmitter (June 2005 *PW*), the Montis cannot normally be used as a stand alone 'crystal' controlled transmitter on 3.5MHz, or other bands. This is because it does not have any facilities to generate its own local oscillator signal. However, like the Mallet, it does have provision for driving the optional 10W linear amplifier. (See the information panel for prices and how to order, etc.).

Relatively Easy DSB!

The generation of d.s.b. 'phone signals, with a suppressed carrier, is relatively easy using a balanced modulator. And this design features yet another use for the ubiquitous SA602 mixer chip!

One input is the modulating audio and the other input is the radio frequency (r.f.) carrier frequency, which comes from the local oscillator (l.o.) output of the receiver. This is shown in the bottom part of the block diagram, **Fig. 1**. The output of the balanced modulator is thus at the desired output frequency and no further filtering or mixing is required - unlike a superhet.

Because the frequency varies with the band, removing the unwanted sideband (to make it single sideband) would be very complex and contrary to the KISS principle! By providing both sidebands, there's no need to switch them according to convention for each band – just like the receiver. The main disadvantage of d.s.b. operation (spectrum inefficiency) is hardly worth mentioning for QRP operation!

The rest of the transmitter is made up of the driver and output r.f. stage, with filtering, and the controls aspects. This makes the d.s.b. approach the obvious choice for 'phone transmission to go with a direct conversion (DC) receiver.

Mostly MOSFET

The circuit, **Fig. 2**, shows that metal oxide semiconductor field effect transistors (m.o.s.f.e.t.s) are used extensively. In fact they're used for all stages apart from the balanced modulator and transmit-receiver (TR) relay control.

The speech amplifier TR306/7 uses two BS170 devices in a d.c. feedback pair – the first stage providing the gain and the second acting as a low impedance output buffer. It's a very handy circuit 'block' for use with low' impedance dynamic microphones of the type commonly sold at rallies for less than £1.

The microphone gain preset, RT302, is used to make certain that the following balanced modulator stage does not clip at its output. The speech amplifier is active all the time (to avoid nasty TR thumps), with the push-to-talk (PTT) switch turning on the TR relay RL301 and the balanced modulator whose supply is stabilised with the 6V Zener, D302.

The output of the modulator is buffered by TR304 to drive the **RF Drive** preset RT300, which in turn drives another BS170 m.o.s.f.e.t. feed back pair, but this time arranged as buffer followed by amplifier!

The supply currents are larger here so these devices are

little set. I've used it extensively across its frequency range, the 1000 memories have proved to be invaluable for storing the local frequencies of interest.

The transmit audio has been reported as "punchy and clean" so no complaints there. Although, in the interest of extending battery life, it would be nice to see an ultra low power level in addition to the 500mW level, but aside from that I've no complaints.

The set, along with most of its contemporaries, makes extensive use of shifted functions on the keypad for setting of operational options. Additionally, there's a menu system accessed via the encoder or by using the Up and Down buttons on the keypad.

Passing On Settings

With such a configurable set, it's only reasonable to expect that the manufacturer would provide the ability to easily pass on the setting from one radio to another. In this case Yaesu have provided a clone function with the FT-60 so that you can create as many copies of your memory configuration *(see opposite) as you have friends owning FT-60s.

A special lead is required to connect the two sets. In usual Yaesu fashion the clone lead fits in the Mic/Speaker socket, which is located hidden under a grommet on the right hand side of the case.

Note: I think it's a pity that there's no facility to back-up or modify the setting via a PC as I found this to be a very useful feature with my VR-500 wide-band hand-held receiver. It's certainly much easier using a computer keyboard to enter memory data with full sized fingers!



Fig 2: The transceiver has an power supply, which provided G3UNR with "Over 10 hours operation" (see text).

On the subject of controls, the layout is pretty conventional with the Volume, Squelch and rotary encoder for Frequency and other control being located on top of the set. The encoder and the squelch control are concentric with the smaller knob of the combined volume and power control located in between the encoder and the antenna socket.

The 16 button keypad is to be found located in the bottom third of the front panel with the speaker positioned above. The internal microphone sits just below the speaker on the left integrated into the radio's nameplate.

Uppermost on the front panel lives the FT-60's display, which is described by the manufacturer as "large". I think they must be referring to the large characters because the display is only 35 x 15mm!

It is however, very readable, especially with its pink/orange back lighting. Very effective and it doesn't effect your night vision too much either. Great when playing radio in the dark, as the keypad is also illuminated!

The FT-60 also offers some interesting security functions. For example it's possible to set password protection so that the radio won't allow unauthorised use. Additionally, you can configure it to only operate on single band or from certain memories.

* Please contact Yaesu UK direct for further information. Editor.

Outdoor Adventurer?

If you're an outdoor adventure type then there are a couple of facilities that may well be of interest to you. Firstly, there's a beacon function which is initiated by another radio that sends a pair of CTCSS tones that match the settings on your radio.



Fig. 3: The FT-60 incorporates an SMA antenna connector (see text).

Your FT-60 then responds automatically by transmitting either a periodic tone or, if the FT-60 is set to continuous, then it will transmit audio from the microphone at maximum microphone gain and your callsign in c.w. (assuming it has been set via the menu). This is a great idea for Amateurs operating in mountainous or other hazardous environments.

Additionally, the FT-60 provides a different function with a similar use. The automatic range transponder system (ARTS) ensure that when two FT-60s are in range of each other, this is determined by the sets periodically polling each other, all is well. Once the sets lose contact they raise the alarm by beeping. This feature is quite common on PMR446 sets and can be a useful function - inducing real, or sometimes unnecessary concern!

Spend My money?

The big question to ask any reviewer in my opinion is; "Would you spend your own money on the product"? The answer, in the case of the FT-60, considering the performance and price tag of under £200, is " Yes I would". That is, if I didn't already have quite a few hand-held transceivers and scanners. But at that price, it would be high on my 'to buy' list. Especially as the FT-60 is such rugged, water resistant, go anywhere kind of radio.

It's been a real pleasure getting acquainted with the hardy little FT-60, it will be a shame to let it go. I've got very used to it either sat just by the main shack desk next to my computer screen or out and about with me wherever I go.

There's an empty space there now, I wonder what I can fill it with? One last thing before I go, a huge thanks to Yaesu UK for the opportunity to get to know this fine robust hand-held. If you want to know more about the FT-60 then contact **Yaesu** at **Unit 12, Sun Valley Business Park, Winnal Close, Winchester, Hampshire SO23 0LB. Tel: (01962) 866667** or take a look at their informative website at **www.yaesu.co.uk/amateur/index.htm** **PW**

Product

Yaesu FT-60 144/430MHz Transceiver

Company

Yaesu UK Ltd.

Contact

Sales, **Tel: (01962) 866667, FAX: (01962) 856801. E-mail: sales@yaesu.co.uk**

Pros

The FT-60's functionality combined with its excellent Ni-MH battery capacity make the radio a prime candidate to accompany me most everywhere I go

Cons

I'm sure it will be a disappointment to some as it is features an SMA connector. For some reason these connectors seem to be much maligned by the Amateur Radio community, but they are very effective and treated properly, robust too.

Price

£189

Supplier

My thanks for the loan of the review transceiver go to **Yaesu UK Ltd, Unit 12, Sun Valley Business Park, Winnal Close, Winchester, Hampshire SO23 0LB.**

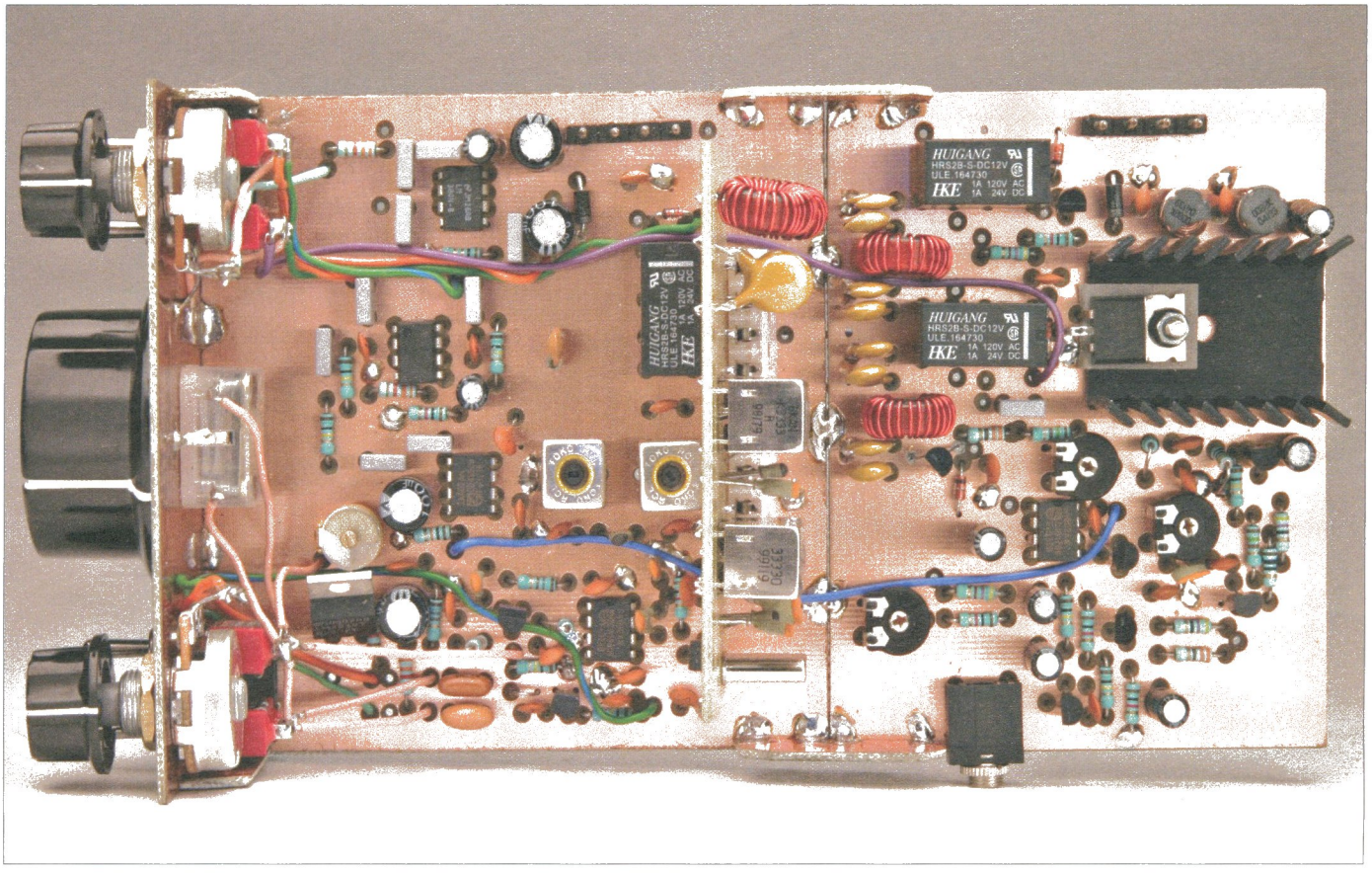


Fig. 3: The completed Montis shown in this photograph is an early version and is different to the version shown in Fig. 5.

must take care to ensure that the insulating washer and bush are properly fitted so that the tab of the IRF510 is isolated from the heat sink and 0V. The device's source lead is only soldered on the top ground plane side so that it is easier to remove in the event of failure!

The IRF510 should then be tested at d.c. first using the bias preset RT301. Measure the supply current with RT2301 set fully anti-clockwise and the p.t.t. switch closed, then gingerly advance RT301 for about an extra 500mA of current. Take care with this adjustment because going too far can make it draw a few amps!

The output low pass filter is then fitted (for use with the Sutton this is made for 3.5MHz). Start with the capacitors – these are installed in parallel pairs – C300 with C301, etc., to give four 'filter caps' of 800pF.

Next, examine the p.c.b. carefully to determine the correct holes because the board has provision for series connection of these capacitors. The inductors, L300/1 are easily wound since they are single layer untapped windings on red T50-2 toroids (remember, each time the wire goes through the hole it counts as one turn. The transmitter is now ready for r.f. testing and should look similar to **Fig. 5**.

Mounting The Transmitter

At this stage, it is best to mount the transmitter behind the receiver (Fig. 3). Then you should make the various interconnections - for supplies, LO signal, receiver antenna input, band card low pass filter, muting, microphone, band changing, etc.

Testing is done initially on 3.5MHz, with the microphone gain and drive pre-sets are adjusted so that neither the balanced modulator nor the output stage is limiting on speech peaks. This is most easily observed with an oscilloscope - yet another use for an invaluable piece of test equipment! But it can be done with your power meter/dummy load, and finally, helpful comments from other stations.

The procedure is to first make certain the output stage is not limiting (by keeping output power to roughly half of full output with the drive RT300). Then you should increase the microphone gain preset RT302 to just below the point where output ceases to increase (as the modulator IC300 begins to limit). Then output is increased with the drive preset RT300 to just below the point where it ceases to increase again - this time as TR301 begins to limit).

Once the transmitter low pass filters have been added to the receiver band cards (provided the receiver works on those bands) it should also transmit on them after satisfactory testing on 3.5MHz.

Output falls off slowly above 14MHz but is usable up to 28MHz. Note: a **small increase** in output stage bias (RT301) may help lift the output on these bands without cooking the IRF510!

You can easily install the transmitter in a case but please do make certain it has plenty of ventilation! Additionally, I strongly recommend you get used to operating it on 13.8V **before trying higher supply voltages**. Finally, if you decide to add the linear amplifier, it too must be mounted close to the transmitter to minimise lead lengths.

On The Air

Radio Amateurs are often nervous of double sideband suppressed carrier 'phone operation. But it's fully compatible with other stations using s.s.b! As far as the other station is concerned, they may not even realise that you are using d.s.b.!

only turned on during transmission. To operate on the higher frequency bands, a low output impedance is required to drive the gate capacity of the output stage IRF510; this is achieved with a 2:1 step down transformer in the drain of TR302. In addition, the gain of this pair is increased at h.f. by reducing the feedback to the gate of TR303 by the inclusion of L305 in the feedback path.

The output stage TR301 has the same arrangement for getting rid of unwanted harmonics as the Mallet transmitter. This is a relay selected filter on the transmitter printed circuit board (p.c.b.) for 3.5MHz, or the filter on the receiver band card for all other bands.

Because the filter is the same 50Ω design for both transmitters, the same band card can be used for both. Like the Mallet, the Montis p.c.b. has provision for series or parallel connection of the filter capacitors that could suit other bands with an external variable frequency oscillator (v.f.o.).

Because the output stage has to be linear for the amplitude modulated signals of d.s.b., the IRF510 is operated with a small standing current, set by the bias preset RT301, fed from the p.t.t. switched regulated supply for the balanced modulator. The optional Linear amplifier is connected to the two points L so that it does not require its own TR switching/filtering.

Building The Montis

Let's now look at building the transmitter, which also uses a double-sided p.c.b. with a continuous ground plane on the top component side. (Later it will be mounted close behind the receiver so that their two ground planes can be joined together efficiently for r.f. purposes see **Fig. 3**.

As before, construction begins with the larger parts that can only be fitted in their intended places - the relays and pre-sets.

After fitting the control aspects, the speech amplifier is built. This is easily tested with an external power amplifier or that of the receiver. Use headphones and connect its input to the output of the speech amplifier - you should be able to hear your own voice through the microphone and speech amplifier.

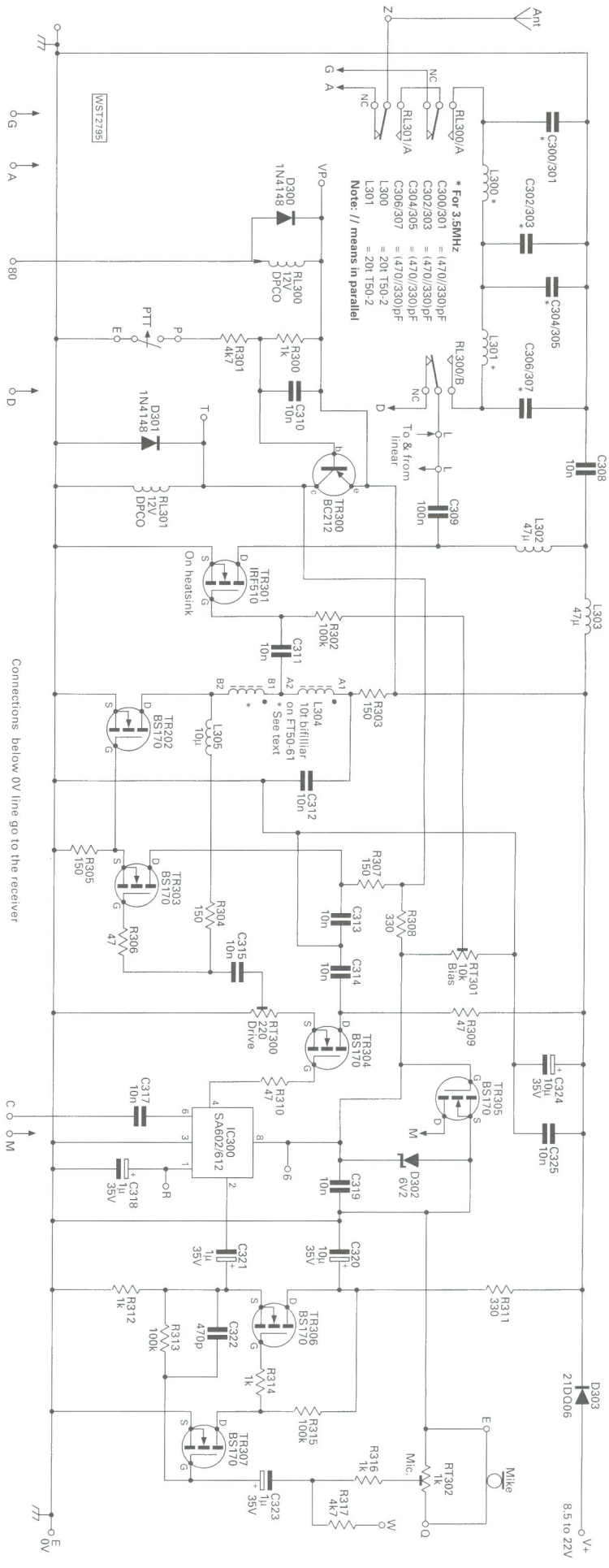
The balanced modulator is fitted next; and as in most applications of the '602, d.c. checks can be done easily. The input pins 1 and 2 should be equal at about 1.25V d.c. and the two outputs (pins 4 and 5) should also be equal at near 5V.

The r.f. driver stages TR302/3 require a bifiliar toroid to be wound. Take heart – **this is not difficult** and the instructions explain it fully!

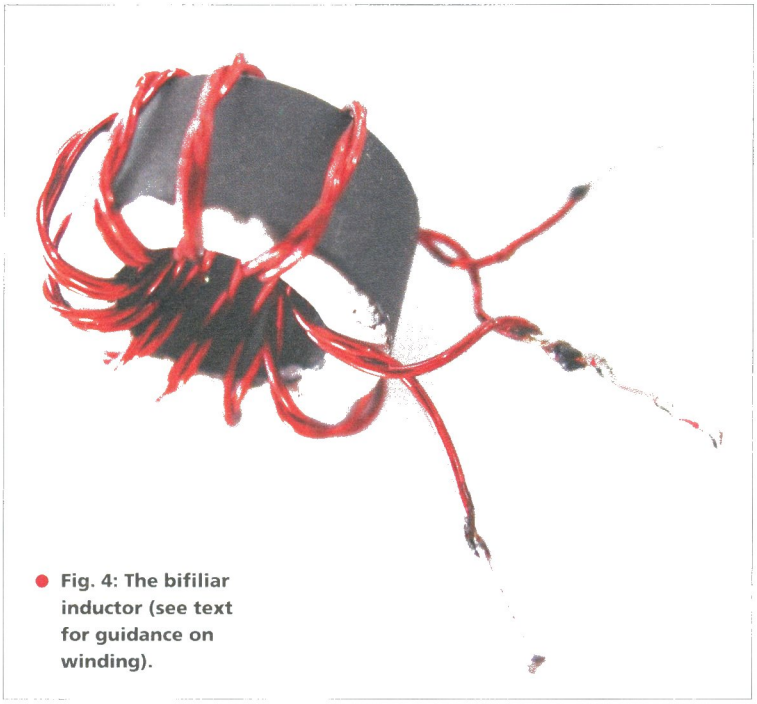
To make the toroid a length of thin wire is formed into a twisted pair and then ten turns are wound onto the black FT50-61 ferrite toroid. This material is good for h.f. broadband transformers **and other types of toroid should not be used**. The individual wires should be identified with your multi-meter and connected to form a centre tapped winding, see **Fig. 4**.

When installed with the other parts for these stages, the d.c. voltage on C312 is measured – it should be near 4.5V (when the p.t.t. switch is closed) confirming the feedback loop is biasing these transistors properly.

The output stage comes next – and like the Mallet, you



● **Fig. 2: Circuit Diagram of the Montis transmitter.**



● **Fig. 4: The bifiliar inductor (see text for guidance on winding).**

The operating procedure is exactly the same as normal – just tune the receiver for best clarity of the other station (because the Sutton is a DC receiver it hears either sideband) and then go to transmit! Because the receivers **Fine Tuning** control is not required for setting a receive only offset to create a c.w. beat note, the **Fine Tuning** control will also alter the transmitted frequency.

The receiving station can listen to either sideband if it helps them to dodge QRM as they should be of equal quality and strength. The advice for antennas is exactly the same as for the Mallet – balanced full sized high ones for preference!

Gremlins: So far, I am only aware of one gremlin and I don't think it has escaped! The original band card track layout had a small error, which only materially affects 1.8MHz. That band needs an **Issue 2** card – all other bands can use issue 1A or 2 band cards.

Thank You Everyone!

Finally, I would like to publicly thank the Sutton family 'early builders'; **Andy Howgate**, **Richard Booth**, **Keith Woodward** and **Jim Gearey**, who perform that vital task of checking the instructions and checking that designs do work!

I hope you have enjoyed this series and have located these villages in Somerset! As ever, I am always pleased to have comments from *PW* readers. **Tim Walford G3PCJ**.

PW

Buying Your Sutton Family Kit

Kits for the **Sutton** project are available from Walford Electronics. They include all parts, including a drilled p.c.b. front panel, to build them in the 'open' style as illustrated in the accompanying photographs.

Prices are:

Sutton 3.5MHz receiver, £49,

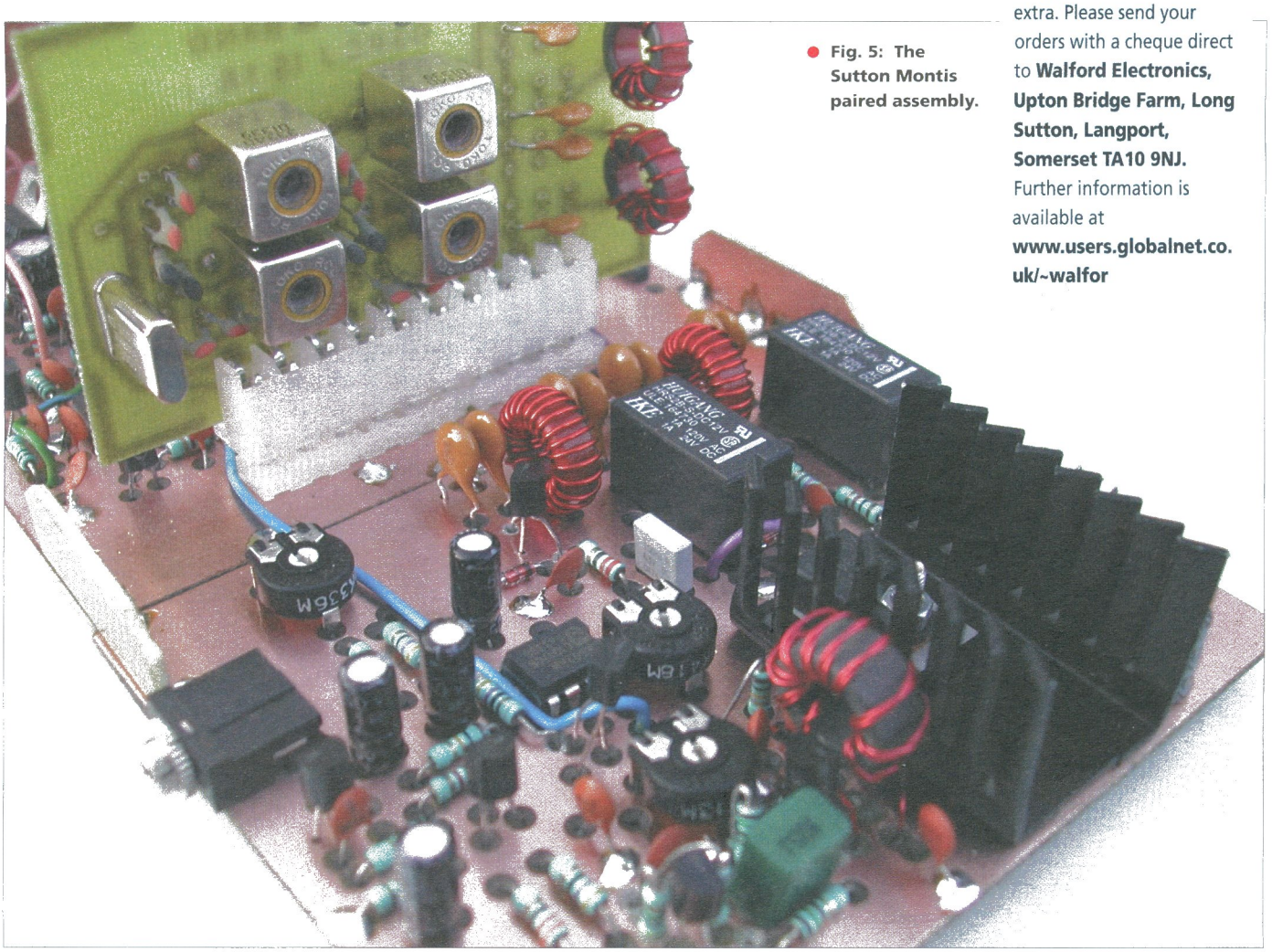
Optional band cards (1.8, 7, 14, 21 28MHz), £15 each

Mallet c.w. 1.5W transmitter, £35

Extras for amplitude modulation, £20

Montis d.s.b. 'phone 1.5W transmitter, £35

Note: If either transmitter is ordered with the receiver, there will be no P&P charge, otherwise P&P is £2 extra. Please send your orders with a cheque direct to **Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ.** Further information is available at **www.users.globalnet.co.uk/~walfor**



● **Fig. 5: The Sutton Montis paired assembly.**