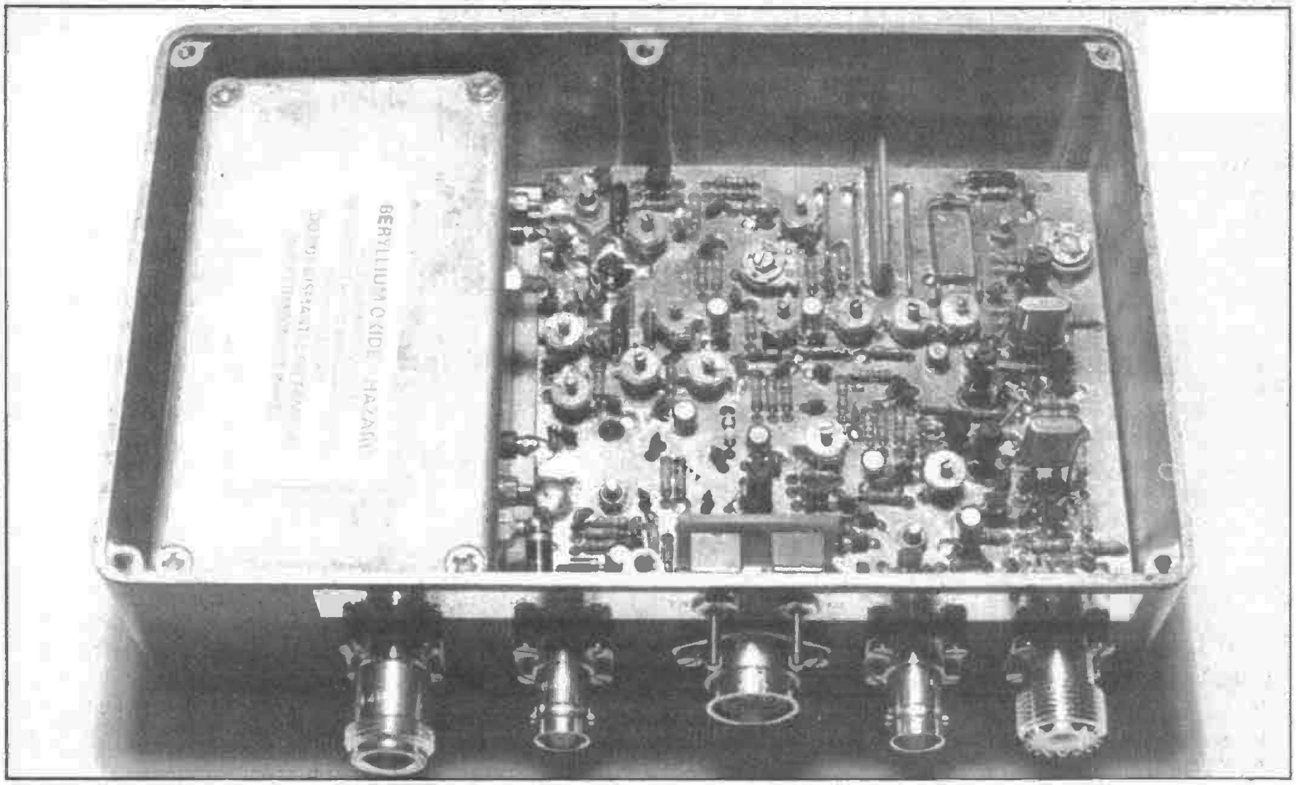


TRANSVERTER ON TEST

The idea of a transverter is to take the output from an HF rig and convert it up to the band you're interested in. Here, Nigel Gresley puts the MMT 432/28S through its paces.

In the last issue you saw Angus McKenzie having a peer at transverters and black boxes. Here and now, we take a look at a typical amateur-type transverter from the firm whose name is always associated with transverters and has been since the year dot – that's to say Microwave Modules of Liverpool.

The idea of a transverter is to take the output from an HF rig and convert it up to the band you're interested in, which in the case of this review is 432MHz transverted from 28MHz. MM do one up to 144MHz as well, which must have sold thousands over the years,and they also make one for 70MHz. There's also a 1296MHz-from-144MHz beast, which we really must take a look at sometime. 1296 is getting more popular every day, and the MM device seems to be a popular way of getting on the band.

Anyway, what about the 432MHz version? It's in the usual MM die-cast box, with the sockets for 432MHz in and out and 28MHz in and out; the name "transverter", of course, comes from "transmit" and "converter" and of course it doesn't only convert the transmitted 28MHz to UHF, it converts the 28MHz band into a sort of tunable IF for 2MHz of the 432MHz band. Actually, the MM job has a couple of switches so that you can opt either to transvert to the "DX" section of the band or the satellite area a couple of MHz higher, which is a nice touch.

The supply volts come in on the usual MM-style multiway DIN socket, and they thoughtfully supply the matching plug for it. The 432MHz transverter containing both RF VOX, so that it switches to transmit with a whiff of RF, and also a hard-wired PTT whereby you apply earth to one wire and it goes to transmit – this connection is also on the plug.

Taking the top off and peering inside shows that this unit is well up to Microwave Modules' usual standards – ie very nice indeed. There's a separate little box inside for the PA compartment, and the transmit and receive small-signal gubbins is all built on one very well made pcb. As supplied the unit needs about half a watt of 28MHz drive on transmit but there's an internal pot so that you can vary the level from 1 milliwatt to 750 milliwatts, which is a very useful facility – we tested ours with an Icom IC740 that only produces a few millwatts at the separate transverter socket, but there was more than enough for the MM transverter to do its stuff with. Also inside are the separate switches that enable you to transmit or receive on either 432-434 or 434-436MHz, assuming you have 28-30MHz available on the HF rig.

The way this transverter works is to start with an oscillator on 101 MHz (or 101.5MHz if you're using the satellite which is doubled twice up to 404MHz. This is used as the local oscillator on receive, following a couple of RF stages using a BFR34A and a BFY90 – the mixer itself is a 3N204. On transmit, the 28MHz drive is mixed with the 404MHz in a pair of 3N204s and this is followed by a couple of BFY90s and a 2N6256 to amplify the drive to a reasonable level for the PA stage. This latter beast consists of a 2N5944 driver and a CM10-12A PA stage and the whole deal is specified as producing 10 watts of FM, CW, SSB or what-have-you. The beauty of a transverter, of course, is that it doesn't care a bit about what mode it's transverting so anything that's available at 28MHz will happily emerge at 342MHz none the worse.

One thing that needs to be watched with every transverter ever made is that there's always a tendency for there to be a bit of the main mixer oscillator – which as we've seen in this case happens to be 404MHz – in the output. MM say theirs is better than –65dB in this respect, as indeed it is, but it's an important point and it's been the death of many a home-brew machine. 404MHz isn't a million miles from 432MHz, after all, and you need some pretty purposeful filtering inside the unit to make sure it doesn't escape.

"Constructionally speaking, everything looked solid and thoroughly British"

In fact, one of our own house rules is always to use a nice sharp bandpass filter in the antenna to and from any transverter just in case the filtering decides to have an off day and let out something it shouldn't. It's even worse with a 144MHz transverter, because the injection here is at 118MHz (144-28 = 116) and that's in part of the aeronautical navigation band. We're quite fond of aircraft, and the F-111s from Upper Heyford give us a private air display every now and again, but the last thing we want is for some aviator to decide that our antenna system is the beacon he's homing in on instead of the one at Heathrow or whatever, so good filtering to make sure that naughty signals don't escape is a must with transverters. You also wouldn't want troubles with the neighbours, would you ?

Coming back to earth *(oh, funny – can't you give him a pill or something? – MD)* MM give you a nice manual which explains all the principles and gives you a specification to read. There are also come circuit diagrams and a block diagram, so you can find your way around with no trouble at all. Constructionally speaking, everything looked solid and nice and thoroughly British and even Technical Face couldn't find anything to grumble at. Another plus point is that MM supply all the plugs, sockets and what-have-you so you can get on the air more or less as soon as you have it home and get soldering.

So, having sniffed around the box and gawped at the circuitry it was nearly time for plugging in and firing up. There was a bit of a hitch here because we hadn't realised that the IC-740's output was quite so low at the transverter socket on 28MHz, but we soon sorted that out – the adjustment procedure is simple and well explained in the manual. The antenna in use was our trusty old 19-element Tonna (we'll soon be doing some antenna reviews so if you hear a yell followed by a resounding crash you'll know that we stepped back to admire the Monster Megabeam we just put up on the roof and forgot that there's a 40 foot drop . . .) and we thought we'd try the machine barefoot first and then maybe apply the big linear if there was anything interesting happening on the band.

So we applied the volts; we used a 12 volt supply, although the thing is apparently happy at anything between 11 and 13.8 – and a nice reassuring noise was audible in the receiver. We pointed the beam in the general direction of GB2SUT at Sutton Coldfield and – nothing. Oh. Let's try GB3MLY in Yorkshire, which is usually about the same strength as 'SUT here. Not a tweet. Oh well, wind the beam round and see if we can hear GB3WHA – yes, there it was, about 5 and 5, a bit better than usual! 432MHz can be a very odd band sometimes, we said to ourselves as the heart-rate returned to normal! At least it's all working.

We spent an hour or so listening around and getting the feel of the receiver side of the transverter. General feeling was, not bad. So the next step was to have a couple of SSB contacts. The audio was reported as very nice indeed although with a little bit of FM on the signal – oh dear, what can that be? Cutting about twenty minutes' worth of story short, the power supply we were using didn't take very kindly to having 432MHz SSB sprayed around it and was retaliating by varying its output volts quite wildly; a couple of capacitors, a ferrite bead, and the problem went away. Reports then said "nice audio, like it, wonder what the rig is?" which made us smirk a lot.

Better noise figure

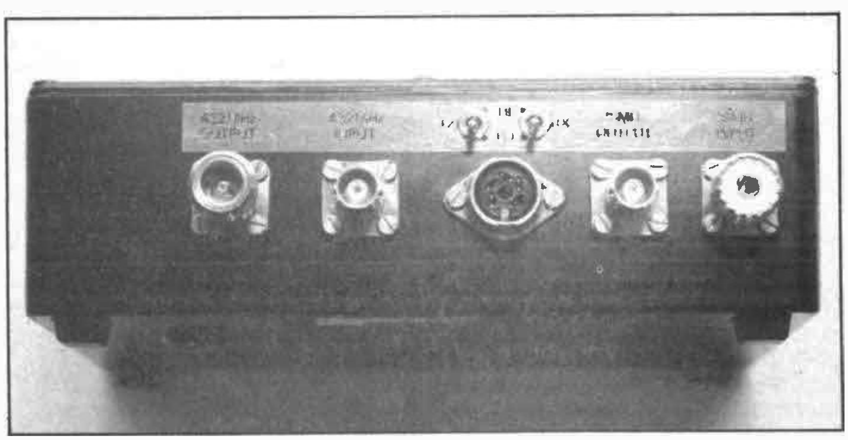
Anyway, the next step was for Boris to take it away into his den and give it the once-over with the test gear while we got on with something else. However, it didn't pan out quite like that because of all things, we had a power failure about five minutes later! We wondered whether the technical department's pet linear had proved too much for all the main fuses, but it turned out to be a cut over a small part of Oxfordshire including ourselves – so that was the end of wireless for the day and we went to the pub. Great things, candles.

So next morning it was back to the lab tests. We had a look at the receive side first, and the noise figure was the first measurement. It came out as about 2.5dB, which is better than MM specify and good for this type of design. Overall gain turned out to be exactly 30dB, just as the spec says, and herein lies a point worth making – 30dB is quite q lot of gain to stick in front of an HF transceiver if it isn't designed for it, and could cause some overload problems. The IC740 takes you straight into the mixer when you're transverting, bypassing its RF stage completely, and this is a Good Thing, but you can't do this with every HF rig we know and you might have to play with attenuators to get the overall gain distribution a bit more reasonable.

". . . A lot of gain to stick in front of an HF transceiver if it isn't designed for it"

MM don't specify the image response of the receive side of their transverter and we thought we'd better measure it on the grounds that it can be important in some parts of the country – the image frequencies, of course, are at 404 minus 28MHz, which comes out as 374-376MHz. At 376MHz, taking the average. the image rejection was -26dB, which isn't bad but it certainly isn't brilliant – there's another good reason for having a nice sharp bandpass filter in the feed from the antenna. We measured another one belonging to a friend of ours in Oxford in case ours was a bit of a rogue, but his one measured -24dB instead! OK, it probably doesn't matter on 432MHz as much as it does on 144MHz – the image frequency there would be 86-88MHz, which is a very busy part of the radio spectrum in most parts of the UK – but it could be improved.

Opposite page: With the top off, the 432/28MHz transverter looks neat and well put together. With the supplied circuit diagram and manual, you can easily find your way around. MM supply all the plugs, sockets so you can get on the air almost as soon as you arrive at your front door. Below: Straight on view of the connection points of the transverter.



TRANSVERTER ON TEST

The next item on the measuring list was the third-order input interceptor, which is a measure of how good the front-end is in the presence of strong signals. To be honest, this wasn't too good either – the figure we got on the review sample was -22dBm, which is about the same as your average black box. Now, there are several ways of looking at this. In essence it isn't a very good performance and what it means is that during a contest or at any time when there are hordes of stations beaming your way and doing their thing, it isn't going to be very easy to hear a weak signal because there'll be a lot of intermod products at about S2 all over the band. On 432MHz, you can argue that this doesn't much matter because it's only contests and the occasional tremendous opening that produces activity at this level; true enough. However, 432MHz is getting busier all the time, and transmitter powers are creeping up, so it's worth thinking about.

"But we'd hate to live on a good site near London"

Basically, the signal-handling properties of the transverter aren't exactly fabulous. The chief reasons for this are that it's an old design using quite elderly devices and to some extent trading off a quiet front-end for fairly feeble signal-handling. In many parts of the country that's still a reasonable trade-off but we'd hate to live on a good site near London, say, when lots of QRO stations were on. We'd end up thinking that they were all 10kHz wide, and even though one or two of them might well be that wouldn't console us! However, the technology to get a quiet front-end *and* good dynamic performance is available – GaAsFETs, high-level mixers and whatnot will do the job – and we would dearly love to see the lads in Liverpool updating this part of their transverter, if only to cope with contests and the like. And as sure as eggs are eggs 432MHz QRO DX-chasing is going to be up-and-coming in future and we'd dearly like to see a transverter that would handle it.

Anyway, they were our thoughts on the receiver section – to sum up, nice and quiet but not so hot at handling the loud ones. We thought we'd have a prod at the transmit bit next, and the plot here was to put in the usual two tones and inspect the linearity at the rated power. Rated power, by the way, is 10 watts – ours actually produced 12 and a bit when driven to saturation with a carrier and 12 volts applied to it. The third-order product of 700 and 1700Hz applied at such a level as to produce 10 watts peak envelope power (we've never said it proper like that before) turned out to be 24 dB below one tone of the two, which is a sort of average black-box-type performance. If you wound the power back to 5 watts pep this improved to -28dB, which is better and would drive a linear amplifier quite well and cleanly. However, to put this in perspective, a pair of 4CX250Rs driven to 400 watts will produce a third-order performance of about -37dB, which in practice means a signal which is two or three kilohertz narrower! This isn't a snide dig at MM, by the way – transistor power amplifiers are very difficult to get really good IM performance out of and your average BB (black box) doesn't actually show better than about -30dB even at its best.

When asked to produce 10 watts, by the way, the MM transverter required just on two amps from our power supply at 12 volts. On standby it was taking about a quarter of an amp, and receive it stung us for about 80 millamps.

Looking on the spectrum analyser, the output of the MM beast looked pretty clean to us. The 404MHz spurious was more or less in the analyser's noise floor at about -75dB, which is 10dB better than MM claim and is good. The second harmonic was also as near as dammit 70dB down, which suggest no problems to local TV gogglers. And that was about it! We found that varying the volts between 11 and 13 produced a drift of about 10Hz, which we felt we could live with, and that the overall drift was really quite low and not worth bothering about.

So, what's the verdict? Basically, the 432MHz transverter – and, to some extent, the 144MHz one, which we haven't formally reviewed but which we know well – from Microwave Modules are good, solid, reliable designs that must be consiidered a bit long-in-the-tooth now. We have the highest respect for MM, and certainly their things are well put together,well conceived and nice to have – especially their solid-state amplifiers. However, both the 144MHz and 432MHz transverters are really ready for an update now, both from the point of view of receiver performance and, to a lesser extent, to improve the IM performance of the transmit side.

A real world-beater

Let's face it – the last ten years or so have seen the incease in performance of the solid-state front end to the point where it's the transmitter that causes the bandwidth to be excessive, not weaknesses in the receiver making it appear so. If MM did something about the fornt-end – ie grafted in something like a GaAsFET configured for quite a high current and trading off signal-handling for a bit of noise, or even a decent bipolar, followed by a bomb-proof mixer given stacks of injection – and then maybe pepped up the Tx stages a bit to give us 10dB better IM performance than anyone else, they'd have a real world-beater on their hands. Maybe they could even do a de-luxe version of the standard transverter for twice the price?

But maybe we're just perfectionists. Still, the crystal ball tells us that something like it is the way to go, and we'd dearly love to see a great British company in there and winning. They're a clever bunch up there in Liverpool – maybe if we all ask them nicely . . . . . .

GENERAL		
Frequency coverage	:	*432-434MHz low range* *434-436MHz high range (Oscar)*
Selectable offset	:	*2MHz*
Input frequency range	:	*28-30MHz*
DC power requirements	:	*11-13.8v. 12.5v nominal*
Current consumption	:	*2.1 amps peak*
RF connectors	:	*50 Ohm BNC sockets*
Power connector	:	*5-pin DIN socket*
Size	:	*187x120x53mm*
Weight	:	*900 grams*
RECEIVER		
Overall converter gain	:	*39dB typical*
Overall converter noise figure	:	*3dB maximum*
Input impedance	:	*50 Ohm*
IF output impedance	:	*50 Ohm*
Quiescent receive current	:	*100mA typical*

TRANSMITTER		
Input impedance	:	*50 Ohm*
Input modes	:	*SSB, FM, AM or CW*
Input drive for full output	:	*1mW to 750mW by means of variable input attenuator*
Power output	:	*10watts continuous rating*
Output impedance	:	*50 Ohm*
Relative 404/406MHz output	:	*Better than – 65dB*
Other spurious outputs	:	*Better than – 65dB*
Quiescent transmit current	:	*250mA*
LOCAL OSCILLATOR		
Maximum frequency error at 432MHz	:	*± 5KHz*
Typical drift at 432MHz	:	*2KHz/hour*
Frequency sensitivity (11-13.8v)	:	*50Hz*
Oscillator frequency 432-434MHz	:	*101MHz*
Oscillator frequency 434-436MHz	:	*101.5MHz*