Contesting

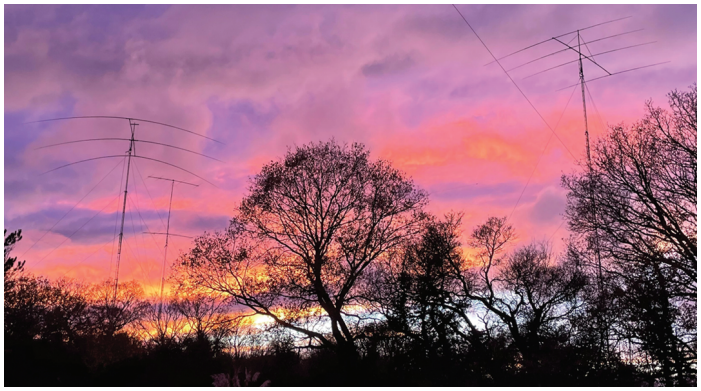

PHOTO 1: Three-element full-size 40m Yagi in fibreglass, four elements on 20m and two sets of five elements on 10m at M6T.

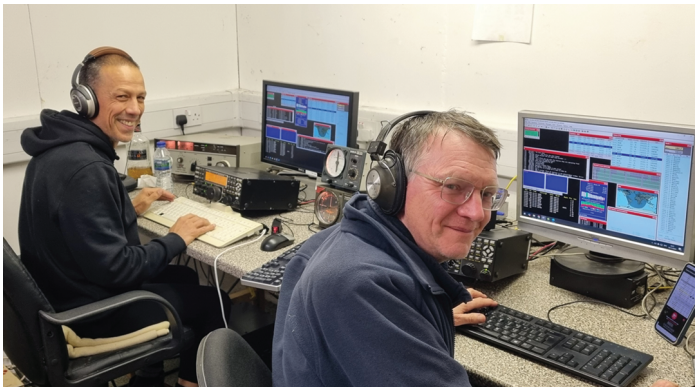

PHOTO 2: DL8JJ and G4PVM operating M6T's 40m station.

Taking part in contests on your own can be great fun and a very fulfilling experience. Entering with a group of people can be even more enjoyable and pooling your resources can help you to build a much bigger and more effective station, travel further afield or take part in a more competitive section in a contest.

There are a good number of well-established Contest Groups in the UK, one of which is the Martlesham DX & Contest Group – known by the contest call M6T.

The group was the brainchild and passion of the late Bob Carpenter, G4BAH who died in 2016. Bob had always dreamt of building a 'multi-multi' contest station, one where each of the six HF contest bands are simultaneously activated from a single location with separate antennas and equipment for each band.

When he first told me of the idea during one VHF Field Day, I grinned at the concept of a row of separate towers each with its own monobander but thought it would never happen. However, Bob was a force of nature and from 1988 began to accumulate equipment and a small team. We took part in a series of contests until the team and equipment assembled was adequate and ready to enter the multi-multi section of CQWW SSB in October 1991, as G0KPW.

Over the subsequent years, both team and equipment grew, regularly placing first in Europe in CQWW SSB. This was the only contest which the team entered at full tilt, because the station had to be built from scratch, field-day style, in the week before a contest and then taken down and packed away on the Monday after. It required a commitment equivalent to going on a big contest DXpedition… but to Suffolk.

In 1999, with 18 masts and towers complete with stacked Yagis for the HF bands erected in the week before the contest, the team set a new European CQWW SSB record as M6T, which it held for 12 years.

2000 was the final year of that field day-style 'multi-multi' station. Bob found a new permanent site in 2006 and slowly we began to rebuild the big station in a more permanent form. Some of the key people who helped to drive the build had busier lives and so progress was at a slower rate with plenty of single operator, multi-single and multi-two contest entries. It wasn't until October 2016, after Bob became Silent Key, that the team was ready to return to the big multi-multi section.

Although the antennas and most feeders sit permanently on the towers now, M6T is still far from a 'turn-up-and-operate' station. Each full-bore contest effort needs a team of around six people for two days to set up the station and then a further day after the contest to disassemble.

Much of this is physical work, winding up towers, guying them off and installing additional temporary antennas. Maintenance is also needed between contests to keep the station fit for purpose.

Station equipment

Each of the six contest bands have their own radio shack, monoband antennas and a pair of networked computers running Win-Test. The antennas in use change over time – the arrangement used for the most recent contest at the time of writing, CQWW CW 2025, is listed in **Table 1**.

All the HF bands have multiple antennas available allowing the station to transmit in more than one direction at once with the run operator selecting which antenna to listen on by a foot switch.

In-band operation

Each band has two radios – one set up as the 'run' radio, and the other as the 'in-band' radio. One operator looks after the run radio and, as you might expect, they primarily solicit QSOs on a chosen frequency. The operator of the 'in-band' radio either listens on the main transmit antennas (when the run operator is not transmitting) or, more often, on a separate in-band receive antenna which allows them to continue to listen while the run operator is transmitting.

Their job is to try to work multipliers and other needed stations on the band, as far as possible without disturbing the run, with QSOs interleaved between the two stations.

Table 1: M6T's CQWW CW 2025 antenna system.

Band	Antennas
160m	T-antenna at 22m + inv-v dipole at 28m. 9 circle + Rx vertical
80m	4-square + inv-v dipole at 28m. 9 circle + Rx vertical
40m	3-el Yagi at 30m + 2-element Yagi at 30m. Rx vertical
20m	4-el Yagi at 30m + 4-el Yagi at 30m. Rx vertical + TH5
15m	2 x 5-el Yagi at 18/30m + Skyhawk Tri-bander at 30m. Rx vertical + TH5
10m	2 x 5-el Yagi at 24/32m + 7-el Yagi at 30m. Rx vertical + TH5

PHOTO 3: Aerial view of some of the antennas at M6T. Photo: G0EGW.

The in-band station is able to interrupt the run station, 'grab' the amplifier and transmit antennas at will. It's very important to comply with the contest rules of a single signal on a band at a time, which is enforced with an interlock between the two radios. When the in-band station transmits, the 'run' station receiver is connected to the in-band antenna so the run operator can continue to monitor their run frequency.

Knowing when it is appropriate to interrupt the run station (and when it isn't) is a key skill and this works best when there is good teamwork between the two operators. Such teamwork doesn't always come naturally and it can be frustrating for a run operator who is not accustomed to this way of working.

But the sum of two people's slightly constrained efforts will generate a bigger score than one person's solo efforts and teams usually become comfortable with this way of operating quite quickly.

All this needs careful engineering to allow the in-band station to hear weak signals a few kHz away from the run station, with antenna separations of as little as 150m. Radios need to have extremely good Blocking Dynamic Range to avoid being desensed by the very strong local signal, both transmitters and receivers need excellent phase noise performance and the transmitters all need excellent composite transmit noise performance.

We at M6T have chosen Elecraft K3 radios since they offer some of the best performance in these areas but other options are available. In-band receive antennas need to be located as far from the transmit antennas as practical, ideally in a direction where the transmit antenna seldom points, so we have our receive antennas to the south of the transmit antennas.

We're still very much evolving this capability at M6T. Other multi-operator stations around the world are better set up than us but we're making progress and the challenge generates interesting engineering problems for us to solve.

Inter-station interference

There are challenges in building an operation with six high-power stations in such close proximity and minimising the interference between the stations is a key part of this. This interference broadly falls into categories of either being harmonically related or non-harmonically related:

Non-harmonically related interference

There is a lot of RF 'floating around' a multi-multi site and transmitters are imperfect. It's essential to have individual band-pass filters for the band in use between each transceiver and amplifier. This will prevent broadband transmitter noise from causing interference to adjacent bands and, very importantly, will keep the RF from other bands which is coupled into adjacent band antennas from blowing up the front end of a transceiver.

I've seen many tens of watts from adjacent bands coming down a feeder on receive but the use of good band-pass filters means it's more than 30 years since I've needed to change a transceiver's front end components during a contest.

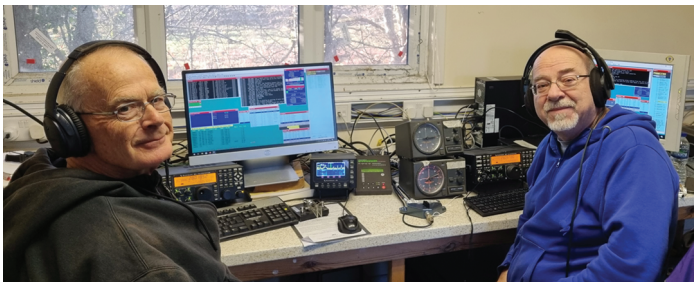

PHOTO 4: VE3EJ and G0PZA operating the 10m station at M6T.

Sometimes you'll get bursts of wideband noise heard across the rest of site from a particular station. This is commonly due to something arcing and it's a good idea to fix this quickly because there's always the chance that the source is about to become a pile of carbon. Sadly, there are many possibilities here: for example, water in a connector, a loose part of an antenna, the end of a dipole having fallen down, a connector somewhere that is loose or an amplifier that is not loaded correctly. You just need to identify the troublesome station and then hunt down the problem.

Harmonically-related interference

Because our HF allocations are harmonically related, interference from harmonics is a fact of life. This is an especially serious problem during CW contests where operation at the bottom end of the bands means that a harmonic from one station can naturally land on top of the operating frequency of one of the other stations. This can partly be avoided by good planning – don't operate at the bottom of the band but go above .025 – which is also helpful because it lands you in the section of the band available to US General Class licensees.

Harmonics are generated in the final amplifier and so the band-pass filter between radio and amplifier has almost no impact on them. The suppression of harmonics directly out of the amplifier is generally insufficient so additional filters are helpful.

At M6T, we use a mix of home-made, ex-commercial equipment and dedicated commercial filters. The home-made filters are coaxial stubs based on a variant of G4SWX's VHF stub filters [1] and [2] and there is additional good guidance on building and using stub filters by K9YC [3].

But don't go chasing ghosts in the wrong places. If your harmonic interference sounds wide and buzzy rather than a pure tone, it's very likely that you are not listening to the harmonic direct from the amplifier but rather to a switched mode power supply somewhere which is picking up the fundamental and reradiating at a harmonic with additional 100Hz sidebands.

This power supply could be anywhere – in the station, in a house nearby, in a phone charger sitting plugged into a car at the station, in a compact fluorescent lamp or an LED light bulb somewhere (even if it is turned off). Hunting and clearing these sources is a true challenge.

References

[1] John Regnault, G4SWX. *Stub Filters Revisited* (*RadCom*, November 1994).

[2] ifwtech.co.uk/g3sek/swxfiltr/swxfiltr.htm

[3] audiosystemsgroup.com/Coax-Stubs.pdf

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