Vintage Gear for M3s – or “sprogs for all”

by Richard Hankins, G7RVI/M3RVI

The need for M3s to observe equipment standards has raised all sorts of questions – particularly where vintage gear is concerned. This article looks as just how bad our vintage gear is – and what M3s (and others) can do about it.

The M3 question

There has been much discussion recently over the question of whether M3 licensees can legitimately use vintage radio equipment, given that the Foundation license includes the clause:

> “The Licensee shall only use transmitting equipment conforming to EC standards or commercially available kits transmitting inside amateur bands only.”[i]

On the face of it, this is a clear statement that no vintage equipment may be used, since clearly nothing made much before about 1996 will have any sort of approval sticker attached.

But are we talking about “approved” equipment here? The words used seem to have been chosen carefully to avoid imposing that requirement. This reading is given further weight by the RSGB’s statement that any equipment up to 20 years old is likely to meet the requirements (nearly all of which cannot possibly be “type approved”).

Plainly, being limited to equipment up to 20 years old will not satisfy many VMARS members, who want to use kit much older than that! So we need to look a bit more closely at this requirement to “conform to EC standards”. No guidance on which standards are applicable has been forthcoming from the RA, but a search has shown that the standard to apply is EN301 783[ii], which is specifically aimed at commercially available amateur radio equipment. So what requirement does this standard impose?

The requirements

Essentially the standard ensures that the equipment will not cause undue interference to other users of the radio spectrum, by limiting conducted emissions on the antenna connection and radiated emissions from its case. The requirements on the antenna lead are given in the table below, and are measured using a power attenuator and spectrum analyser or test receiver.

Frequency Range	Test Limits
0,15 MHz to 1,7 MHz	-36 dBm or -60 dBc whichever is higher
1,7 MHz to 35 MHz	-36 dBm or -40 dBc whichever is higher
35 MHz to 50 MHz	-40 to -60dBc or -36 dBm whichever is higher
50 MHz to 1 000 MHz	-36 dBm or -60 dBc whichever is higher
>1 000 MHz	-30 dBm or-50 dBc whichever is higher

Note that “dBm” in the above table is dBs relative to 1mW (in 50 ohms), and “dBc” is dBs relative to the full PEP output of the transmitter.

The limits for radiation from the case are the same, but start at 30MHz rather than 150kHz. I am not dealing with this aspect of the problem in this article pending the development of a simple test method. My opinion, based on many years of making such measurements professionally, is that the equipment tested so far is unlikely to have any problems in this area – however this does need to be proven.

How big a problem do we have?

We tested a number of transmitters under the same regime: frequency: 3.6MHz, load: 50 ohms power attenuator, fed directly into a HP8560E spectrum analyser. Photos were taken directly from the analyser screen using a digital camera.

The WS19 belonging to Tony, G3YNT is shown in Fig.1. This was tested with the variometer in circuit, peaked for max output, which was measured at +38.5dBm or 7 watts on CW. Surprisingly, the WS19 actually meets the standard – though only just, with the second harmonic just 1.5dB inside the limit. The “shoulders” that can be seen on the fundamental output are due to the 465kHz transmit oscillator, which is mixed with the receiver LO. These are clearer in Fig.2, which cover the smaller frequency range of 0 to 5MHz.

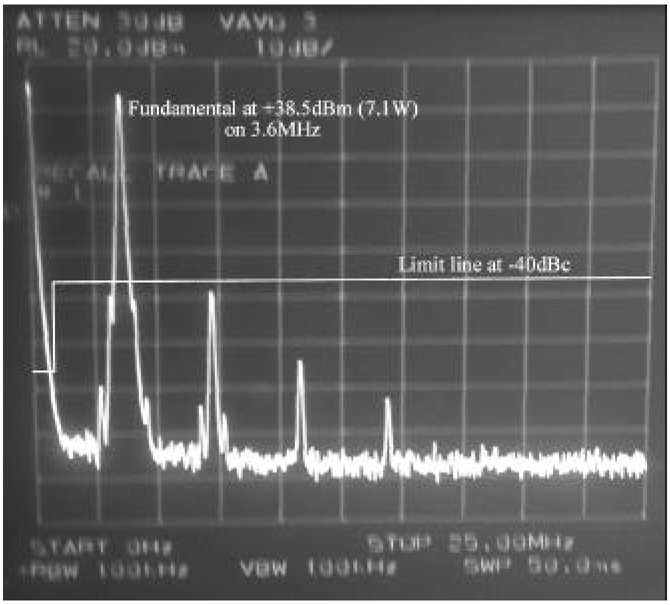


Fig.1 WS19 on CW at 3.6MHz, 0 – 25MHz scan.

Moving on to a real amateur “classic” now – the Codar AT5, which is shown in Fig.3 below. This transmitter uses a VFO in the 160m band, and doubles for 80m output, hence Fig.2 shows harmonics of the 1.8MHz oscillator. Clearly, our AT5 is well out of spec – at 1.8, 5.4 and 7.2MHz.

Turning now to the Pye C12, Fig.4 shows another spectrum rather like the WS19, only with much worse mixing spuriae. Problems are clear, with spuriae at 3.14, 4.05, 7.2 and 10.8MHz all being well over the limit.

Looking at Fig.5 below, we can see that spuriae from the C12 at 465 and 930kHz are also caught by the tighter limit below 1.7MHz. Surprisingly, the C12 could well cause MW interference.

The C12 uses the same mixing scheme as the WS19, but we may surmise that it is worse than the WS19 due to the very simple PA output circuit, which is parallel-C, series-L only – with almost no filtering action at all. The WS19 on the other hand has a proper parallel L-C tank circuit, which plainly helps with the spuriae a great deal - compare Fig. 5 with Fig.2.

More transmitters were tested, but lack of space prevents me including more scan photos. The Heathkit DX100U has similar outputs to the Codar AT5, and fails at 1.8MHz (-26dBc), the T1154 failed at 7.2MHz (-36dBc), however the Tiger Tiglet passed.

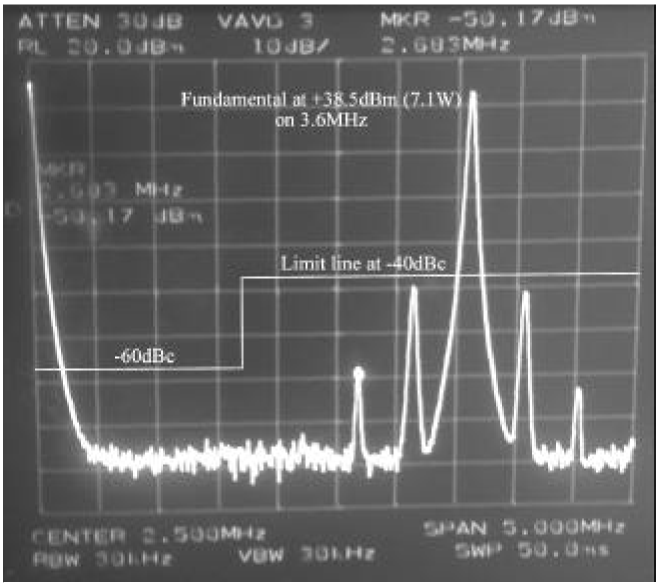


Fig.2 WS19 on CW at 3.6MHz, 0 –5MHz scan

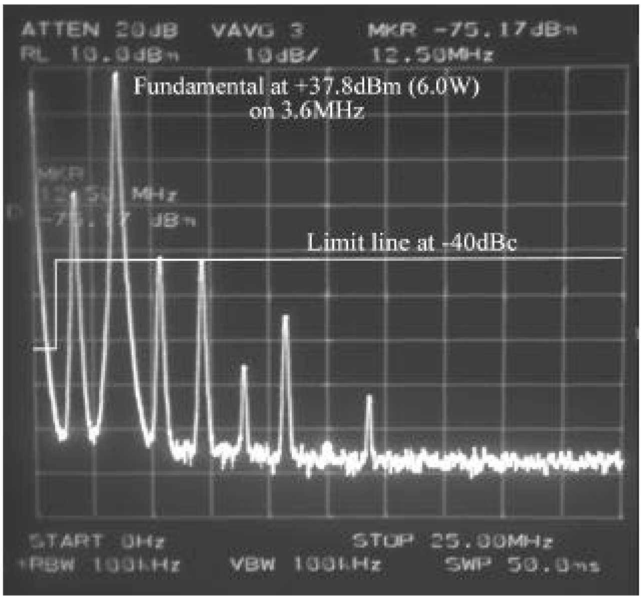


Fig.3 Codar AT5 at 3.6MHz, 0 – 25MHz

The big clean up

Fortunately, improving this situation is fairly easy. Ordinary, low pass filters will not help much here, as we have spurious outputs both above and below the wanted carrier signal. Accordingly I designed a bandpass filter for 80m use only, and Mike Hazell, G1EDP, knocked a up a prototype. Details of the unit are given Fig.6 and Fig.7.

This filter is designed to be used in series with the 50 ohm coax line to the antenna. Construction is non-critical, and ours was made in a box fabricated from offcuts of PCB material. Trimmer capacitors should be chosen with spacing to suit the power level being employed – standard trimmers are fine for the 10W allowed to M3s. If you have a grid dip oscillator, then you can readily make up your own tuned circuits to suit.

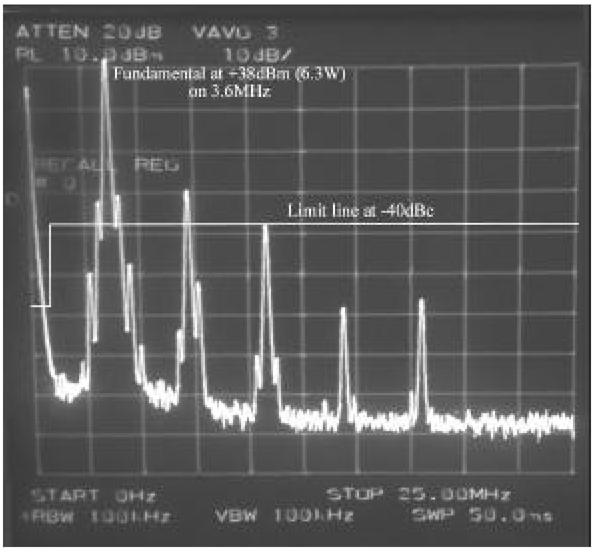


Fig.4 C12 on AM at 3.6MHz, 0 – 25MHz

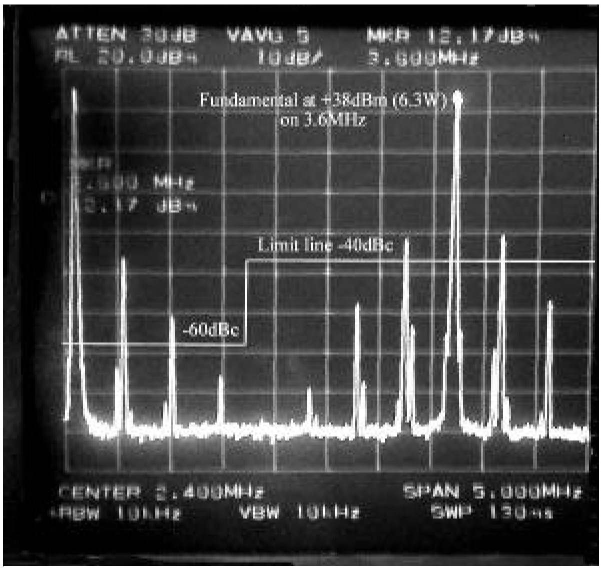


Fig.5 C12 on AM at 3.6MHz, 0 – 5MHz

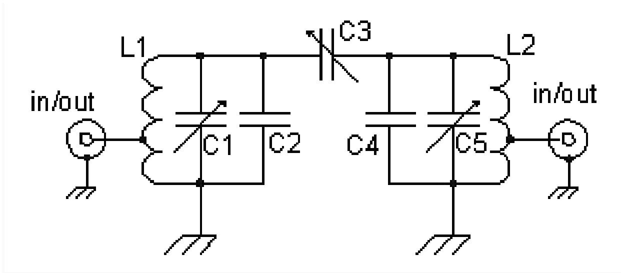
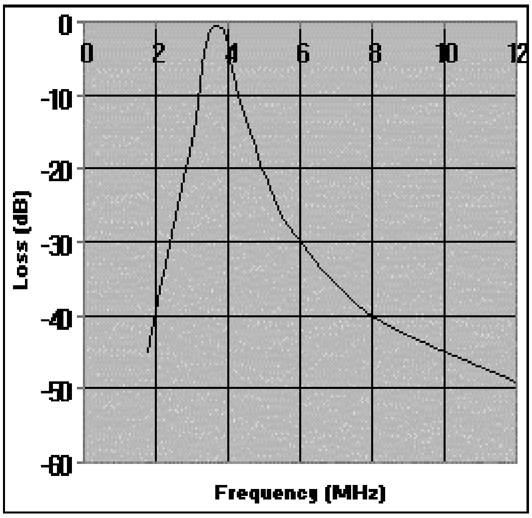


Fig.6 Circuit of 80m filter

L1, L2	16 turns of 1.6mm Cu wire on a 21mm diam. former, turns spaced by wire diam. & tapped at 6 turns from ground.
C1, C3, C5	100pF trimmer, 500V
C2, C4	820pF, 500V ceramic

Fig.7 Our filter prototype



While a signal generator and analyser are ideal for accurate tune up, it is possible to adjust this unit using just a transmitter and in-line power meter. The preset capacitors, C1 and C5 should be tuned for maximum output at the operating frequency. C3 can also be adjusted for maximum output, and the setting may then be checked by tuning the Tx across the 80m band: the loss through the filter should be

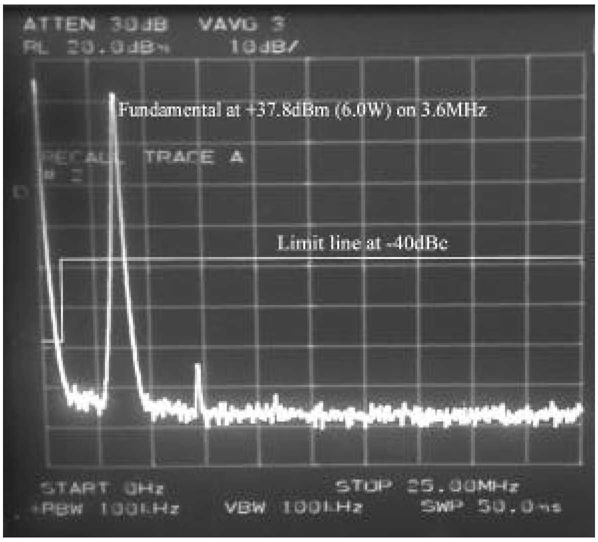


Fig.8 WS19 with filter

<1dB between 3.6 and 3.8MHz, when peaked at 3.7MHz (ours measured 0.7dB loss, which is not significant).

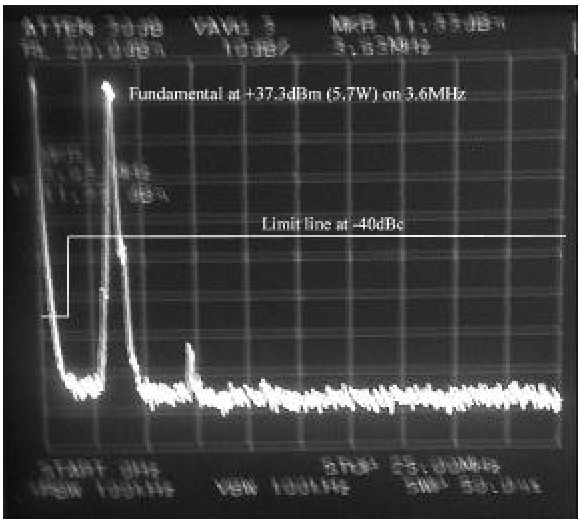


Fig.9 C12 with filter

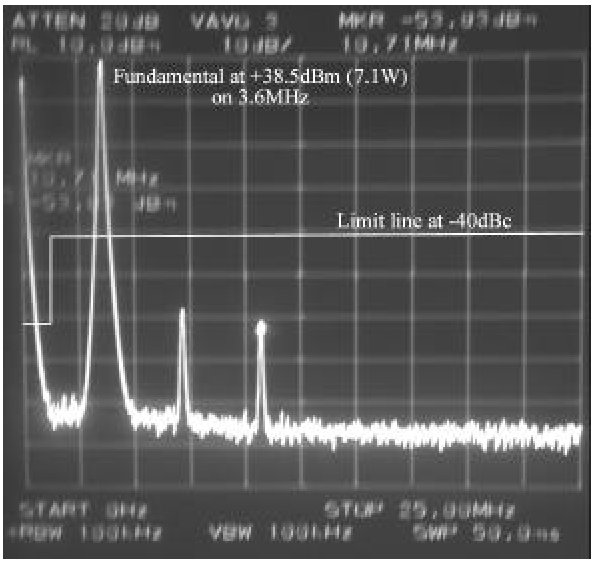


Fig.10 Codar AT5 with filter

It will be evident from the photos of the filtered outputs that the filter is very effective, and all the transmitters checked were brought into line with the EC standard with little difficulty. This is one step to providing M3s with legal use of vintage transmitters.

What is good enough for M3s, must also be good for everyone else, and anyone amplifying the outputs of these transmitters should regard the use of such a filter between the Tx and amp as an essential, particularly if the amplifier is of the solid-state, wideband variety. Such steps should be regarded as mandatory if we are to keep our vintage radio house in good order, and avoid upsetting other users of the spectrum.

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[1] This is clause 4(1) in BR68F.

[11] This is ETSI standard EN301 783, which may be downloaded for free from the ETSI website at http://www.etsi.org/ . Its full title is: "*Electromagnetic compatibility and radio spectrum matters (ERM); Land Mobile Service; Commercially Available Amateur Radio Equipment*" It comes in two parts.