NEWSLETTER ARCHIVES

Methods of Interference Suppression Evaluation of Receiving Loops etc. And the MFJ 1025 Signal Canceller
By Derek G3GRO

Introduction
The experiments reported below were initially sparked off by operation on the new 136kHz LF band but it should be stressed that the techniques are equally applicable to other HF bands to combat local sources of noise or even in the case of the MFJ1025 canceller, to help to eliminate co-channel QRM.

It soon became apparent on the 136kHz band that the ability to resolve longer distance weak CW signals was often being compromised by wide-band pulse interference from a Loran-C navigation aid located at Lessay in the Cherbourg Peninsular operating at around 100kHz. This splatter mainly affects stations in Sussex and along the south coast. The interference level can vary during the day anywhere from S3 to sometimes as high as S7 but is generally around S5 on a good antenna and usually determines the noise floor. It is frustrating to know that weaker continental stations are calling after a CQ and not be able to resolve the callsign!! The first line of defence is obviously to switch off the AGC, use as narrow a bandwidth as possible, and use DSP techniques etc. but this often still leaves a residue of noise which at very least is very irritating and wearing after a while and does limit the ability to winkle out the DX.

As a result, several methods were investigated to combat the interference including directional receiving loops, synchronous pulse blanking, and the use of the MFJ 1025 Signal Canceller. Some of these techniques also have applications to other bands to suppress local noise, TV line-timebase whistles etc. and in the case of the MFJ 1025, cancellation of on-frequency QRM from other amateur stations.

Tuned Receiving Loops
In common with many operators on the 73 and 136 kHz bands I initially tried the use of a multi-turn tuned square loop (used to be called a "frame aerial" !!) of around 1 metre per side as a receiving antenna on LF as an alternative to using the main transmitting antenna for reception as well. Although the absolute sensitivity of the small loop is lower than the omni-directional transmitting antenna, the signal to noise ratio which is more important can often be better with the loop and having a figure-of-eight polar diagram in the horizontal plane, it can also be rotated to null out a source of interference providing that the wanted signal does not lie close to the line of the null. However, I found that although the small multi-turn loop seemed to work adequately for shorter range signals, it did not seem to pick up the longer distance stuff as well as the big inverted 'L' transmitting antenna despite the latter also picking up the Loran QRM originating at 200Km distance. I think that this experience has also been confirmed by other stations including Lech G3KAU and Peter G3LDO in Worthing. So until recently, I used the main LF antenna effectively comprising of 3 parallel wires each around 130ft long strung between 6ft spreaders for both transmitting and receiving. However, more recently I have been experimenting with a larger single turn wire loop of around 80sq metres area to see if I could get adequate sensitivity and at the same time direct the null towards the offending Loran station. Initially the loop was made in a delta shape with the apex of the loop suspended below the main LF wire and with the lower corners pegged out across the garden. Each side of the loop was around 35ft and resonated with a tapped series capacitor arrangement in the centre of the lower leg to couple to a 50ohm coax. Tests on this loop confirmed that this loop had a good sensitivity although not as good as the main LF antenna but by walking round the two lower corners of the delta loop and re-peg them in different positions I could rotate the plane of the loop and thus could orientate the null towards the Loran station and measure the depth of the null. This proved the null to be at least 25dB and thus effectively taking the Loran splatter down to below the noise level. I finally re-located the loop to the bottom of the garden where very conveniently there are two trees, one in each corner, from which a rectangular version of the loop of about 100sq metres could be strung and largely concealed by the trees along the

bottom fence which it just so happens points the null from this new loop along a NE/SW axis and effectively nulls out the Loran QRM which lies along a bearing of 216 degrees true. The null pointing in the opposite direction (NE) runs up across Essex and into the North Sea which means that the optimum coverage area of the loop covers most of the current UK and Continental activity apart from Scandinavia and for most stations I found that the loop was better for reception than the main wire antenna.

The MFJ 1025 Signal Canceller / Enhancer

This versatile unit is designed to accept inputs from two antennas, one input being normally from the main transmitting antenna and the second input from an auxiliary antenna. The objective is either to subtract the signals arriving at the two antennas so as to cancel a particular interfering signal or noise source or alternatively, to add the signals arriving at the two antennas together so as to enhance one particular signal relative to the general background. The unit is designed to cover from 1.5 to 30 Mhz and has internal TX/RX change-over switching with either RF sensing or external PTT line control from the transceiver. There are separate gain controls on each input and the auxiliary channel has an adjustable phase shifter covering a nominal 180 degrees range in each of two switched frequency bands. There is also a push-button selectable phase inversion control - ie. a fixed phase shift of 180 degrees. It is probably stating the obvious, but for the system to either cancel or enhance a particular signal, then both antennas have to be able to "see" the signal in question at adequate strength and be spaced at a significant fraction of a wavelength apart and finally, the noise source must be on a different bearing to the wanted signal so that there is a phase shift between the wanted signal and the source of the interference. If it is desired to cancel a strong local noise source or TV line timebase warble, then only a short wire or whip antenna is needed for the auxiliary input. In fact MFJ produce another version of the unit with a built-in whip antenna.

I initially tested the MFJ1025 on the HF bands with antenna inputs from the main 132 ft wire and a fairly low G5RV antenna bent to fit in the available space. I found that the MFJ1025 worked very well indeed. I could cancel out line timebase whistles on 160 and 80m completely and even cancel a strong S9 SSB signal co-channel with a weaker station underneath and leave the weaker of the two stations fully readable. I did however find on the higher frequency bands that if propagation conditions were unstable with significant QSB in evidence, it was necessary to re-adjust the nulling control from time to time so as to compensate for phase shifts induced by polarisation changes.

Bench measurements indicated that at some frequencies the variable phase shifter did not quite reach 180 degrees which means that it might not be possible to reach a complete null. There was a slight insertion loss of around 4dB at maximum output but there was very little unwanted amplitude change with rotation of the phase control which means that there is not too much interaction between controls when nulling

The MFJ1025 does not cover below 1.5 Mhz although there is a lot of information available on the internet to extend the coverage down to lower frequencies and suggested performance enhancements. For operation on 136 kHz I use the unit unmodified but operated it via a twin channel up-converter so that the MFJ1025 operates at 10Mhz input and then into the auxiliary FT990 tranceiver antenna input.

On 136kHz it is difficult to get enough separation in terms of wavelength between the main an auxiliary wire or vertical antenna to get cancellation as I found when I tried to use my G5RV with feeders strapped as an auxiliary input to the MFJ1025. So I have now have built another loop antenna, similar to the one described earlier, but running at right angles running along the boundary fence supported by the trees which has a maximum response directed to the Loran station. By phasing this loop antenna with the main omni-directional wire antenna using the MFJ1025 a cardioid pattern can be produced with a null that can be electrically rotated in azimuth using the phase control to point in different directions rather like a "sense" antenna in a DF system. By these means, an interfering noise source or other signal can be cancelled. At the same time, the wanted signal is usually enhanced because signals from two antennas are being added in phase. I have now been operating this system for a couple of weeks and I have found it very successful in that I have been able to cancel the Loran QRM and copy easily a number of weak stations and complete successful QSOs which I could not have copied using either the main antenna or the loop antenna alone.

As an example of how effective the cancellation is, I worked ON7YD recently on 136kHz at RST 559 with the canceller in and when I finished the QSO, I could hear a very weak signal underneath from G4GVC who is normally RST579 calling the ON. Initially I was puzzled why he was so weak and then pressed the phase invert button and there was G4GVC at his usual 579 signal but now ON7YD had disappeared. I then reversed the phase again and the ON was back to 559 and G4GVC had gone !!

For any one suffering from very strong local interference or line timebase problems or just as an aid to eliminate that adjacent channel crud from some SSB station who starts up too close for comfort, I think that the MFJ1025 offers a very worthwhile operating aid. Anyone interested in having a demonstration let Derek , G3GRO know and a demo can be arranged.

Derek G3GRO can be reached by email also Visit our LF section

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