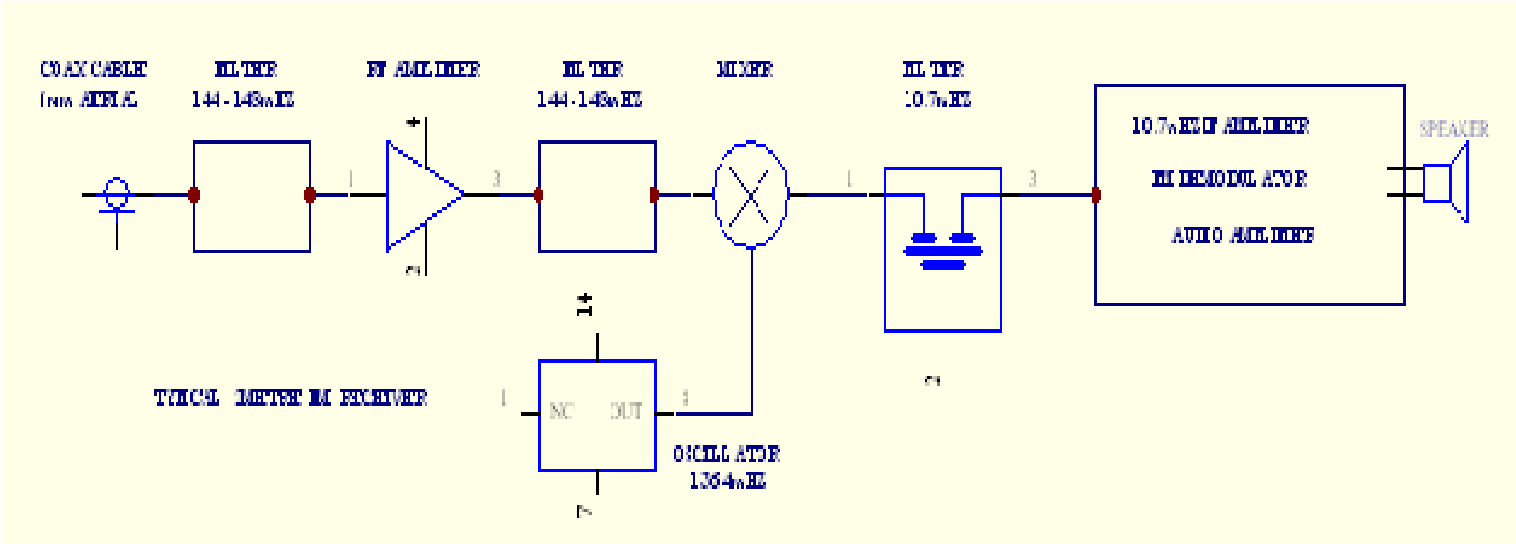
Pager Interference on 2 metre Receivers - what to do. By Peter Ward VK3ZAV

Many hams are having problems with pager transmitters that are on frequencies just above the top end of the 2m band, up to about 148.250Mhz. They interfere with reception on the FM channels we usually use for simplex and repeater working. The first step in solving the problem is to understand what is happening.

You would normally expect that your receiver would not respond to a signal that is on a frequency you are not tuned to. After all when you switch channels, you don't expect to hear the one station on more than one channel, unless their transmitter is about 10 metres away. Therein lies part of the problem, very strong signals, from only a few km away. Pager transmitters run hundreds of watts into high gain aerials, and put out very strong signals.

Lets look at how a typical receiver works.



The aerial coax cable comes into a filter, that accepts signals over the 2m band of 144 to 148 Mhz, or more. Its not reasonable to expect that filter of 4Mhz width to suddenly stop signals about 15 or 30 Khz outside the band, as they will “roll off” gradually over the next few Mhz.

The signal then goes into an RF amplifier, designed to lift the signal strength of the very weakest signal to above the background noise level.

After another similar filter, you have a mixer stage, that is used to convert or change the input frequency of 147.000Mhz down to 10.7Mhz. This requires an oscillator, or locally generated signal, of 136.4Mhz, (147 – 10.7). Your channel changing process simply means changing that oscillator frequency.

The reason for using the Intermediate Frequency of 10.7Mhz, is that its relatively easy to build filters using quartz crystals, that will reject signals from the adjacent channel of 25Khz away. Some receivers use simple filters at 45Mhz, and then convert again down to 455Khz, then ceramic filters to give the adjacent channel rejection. All those stages before the main filters can suffer from overload and or blocking from very strong signals. This means that your intended signal can be no longer audible, or severely interfered with.

Now if that oscillator has some FM noise sidebands, then these too will mix in the mixer to produce a 10.7Mhz output. When you have a very strong signal that is about 1Mhz off (eg. a pager) the signal frequency you are listening to (say 147.000Mhz), then the oscillator noise sidebands 1Mhz

away will produce a strong noise component that will compete with the signal you want. This can result in the signal you want disappearing under the noise.

I noticed that the ARRL tested a 2m rig, Kenwood TM-V708A (others tested were similar), and published the results in QST for April 2006, saying that the adjacent channel rejection was noise limited. The reason for this is that noise sidebands on the frequency synthesizer were stronger than the filter rejection, at -66db. A better designed radio would be many 10's of dbs better than this. Building your own allows you to get the very best performance, QEX is a good start.

Low cost 2m mobiles use Phase Locked Loop systems that use a reference frequency of 12.5 or 25Khz, so these have virtually no inherent noise reduction within the PLL circuit, and this is one of the main problems. The effect of a very strong signal is also to cause the RF amplifier to overload, or distort the signal, causing extra mixing components, and preventing proper amplification of weak signals. Receivers that use FET mixers are about 40db more prone to overload effects than better designed units using, say, diode ring mixers. It is almost impossible to re-design the mobile to reduce these combined effects, so what else can be done?

Because the band occupied by the pager transmitters is quite narrow, it is possible to use a coaxial cavity notch filter. This is likely to be a length of brass tube about 10cm diameter, with an inner tube of 2 to 3 cm diameter and a ¼ wavelength long, short circuited at one end. The real challenge in this is to be able to precision adjust the inner line length to exactly resonate on the pager frequency, to produce a null, without reducing the signal required in the 2m band.

There are sometimes cavities of this type available on the disposals market. Cavities can have loaded Q values of between 2000 and 4000, which means a bandwidth of 148,000Khz/2000, or 75 to 37Khz. This means that your quarter wavelength at 148Mhz or 506.76mm needs to be adjusted to within 0.1mm. The shortcircuit end needs to be fitted with two coax connectors, type N or BNC, not UHF, with a link between them, and this is put in series with the aerial cable.

The GARC has available to it some very large, ex TV transmitter cavities that would work very well for this, but are about 2metres high and 300mm diameter, a little aukward to use with a mobile in the car. One way they could be used with a home station, is to tune it up at ground level, then put it up in the ceiling.