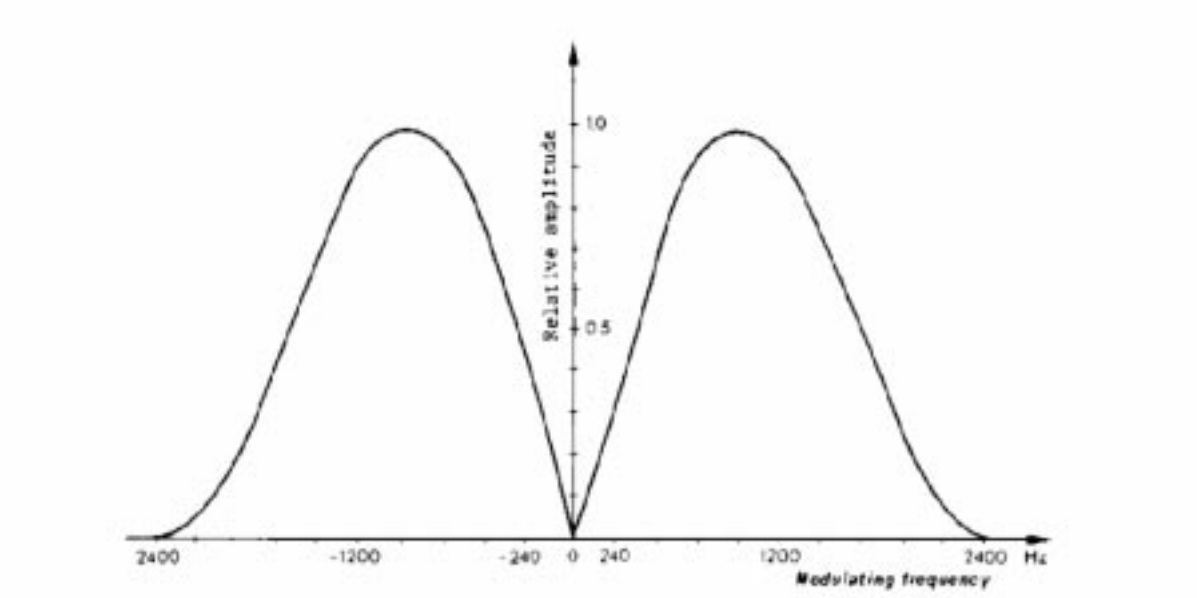
RDS Subcarrier protection within a FM multiplex/composite system.



Spectrum of biphase coded radio-data signals

Figure 1 Courtesy CENELEC

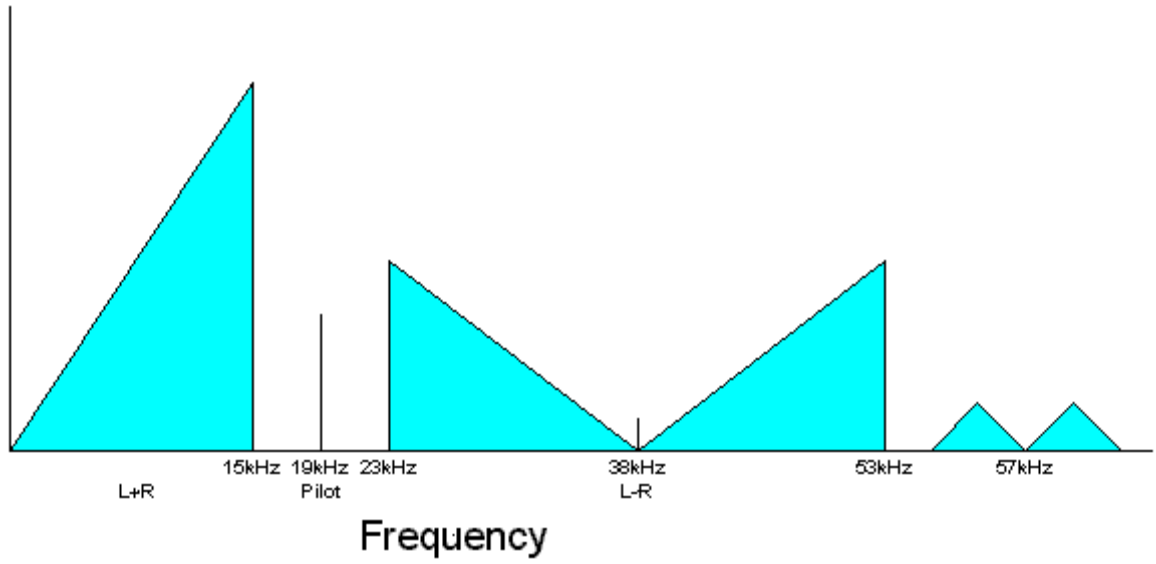


Figure 2 Multiplex Spectrum

The three most common causes of interference to the RDS subcarrier are explained below.

1. Excessive Deviation

This is also known as over-deviation or over modulation. It has two causes which are often both applicable to a system. The first is the lack of any modulation controlling device. This device is normally a deviation limiter (or an audio processor). Without the deviation limiting device, the transmitter will modulate the carrier to a deviation that is a direct function of the incoming audio. This may be tolerable if the audio is well controlled in terms of peak levels but in reality is likely to be totally unacceptable. Normally the carrier deviation should not exceed 75kHz. Without a deviation limiting device, it is not uncommon to see readings in excess of 200kHz.

The other cause of over-deviation is deliberate mal adjustment of the transmitter. Increasing deviation also has the effect of increasing the demodulated audio level from a radio receiver, making the radio station sound loud (more particularly louder than competitors).

The over-deviation causes problems for RDS because it can overload the transmitters modulator, exceed the receivers IF bandwidth or otherwise overload the audio stages of the receiver. This overload is equivalent to clipping or distorting the multiplex signal. Both clipping and distortion produce harmonics which will oftem fall on top of the RDS subcarrier, causing errors.

The only solution is to use an effective, purpose designed, deviation limiting device or audio processor. The sbs MaXiM is a good example of such a device.

2. Composite Clipping

Composite clipping is a method of increasing apparent level of the multiplex/composite signal, giving increased level at the radio receiver output. Composite clipping does not cause over-deviation but the effect of it can be the same as over-deviation.

It is possible to design a composite clipper into an audio processor (usually digital only) that does not significantly degrade the RDS performance. However, the composite clipping must be applied before the 19kHz pilot is added to the multiplex signal. If the pilot was present at the composite clipping stage, the third harmonic of the pilot caused by the clipping process will fall exactly on 57kHz, degrading the RDS. For this reason, a stand-alone composite clipper/processor should never be used.

3. Poor 15kHz Low Pass filter Performance

Normally, the left and right audio channels are filtered before the stereo encodeing process. This filtering is intended to pass all signals below 15kHz without attenuation and to reject everything above that. The stereo encoding process AM modulates (double side-band suppressed carrier) the L-R or stereo difference signal onto a 38kHz carrier. The side-bands of this will extend the 38kHz±15kHz. At the top end this will be 53kHz. If the low pass filters are of poor performance, this will extend beyond 53kHz, potentially interfering with the 57kHz RDS subcarrier. From figure 1, it can be seen that the RDS spectrum is located from 54kHz upwards.

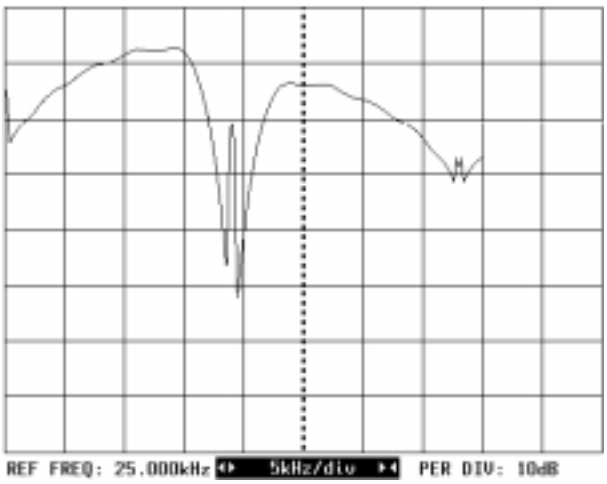


Figure 3

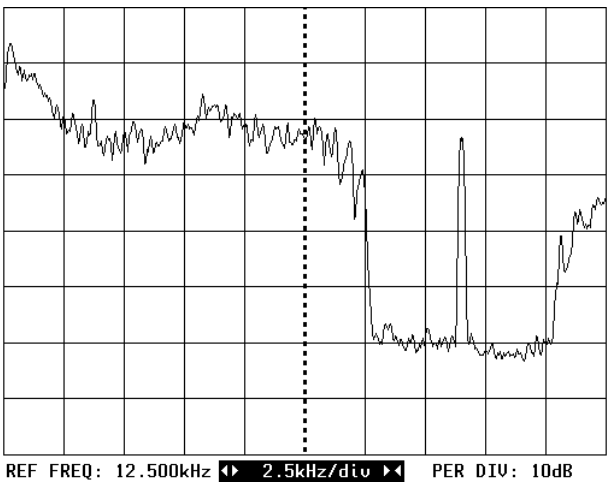


Figure 4

Figure 3 shows an output spectrum from an audio processor with poor 15kHz filters. Because of limitations within the test set, the RDS is not shown, but it is clear that there is significant audio level present up to almost 19kHz. This will degrade the RDS performance. Figure 4 shows the filter performance of a sbs MPX5 stereo

encoder, which has 256 stage FIR digital filters. The filter cut-off is extremely sharp at 15kHz, resulting in good protection of the RDS at above 53kHz.

It is also possible for clipping applied within the discrete left and right channels after the 15kHz filters to have a similar effect to poor filter performance. Good filters in modern equipment will usually be implemented in DSP (digital signal processing) circuits, using a FIR type structure to ensure constant delay. There are virtually no analogue only solutions (using LC or active circuits) that are adequate.

Filter performance is even more critical when multi-band audio processing is used, since high frequencies will often be at much higher levels that are normal.

Conclusion

The performance of numerous components within a FM transmitter system can have a significant affect on the performance of RDS systems. Even some very modern equipment can be very poor, often through attempts to save money or not understanding all of the methods required to protect a RDS system. Manufacturers do not generally provide enough information to assess the performance of their equipment in this regard. Suppliers of RDS equipment can be approached for recommendations, otherwise, products should be evaluated in service.

sbs will be pleased to offer assistance where possible. We can be contacted by email at support@sbs.uk.com.

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