Emission Bandwidth

The radio accepts a 1.25 Gbps (digital) data input and uses it to directly modulate the RF carrier via. On/Off Keying ("OOK" or "DDM" for "direct digital modulation"): therefore, "1s" and "0s" from the digital input directly correlate to "On" and "Off" bursts of RF which are amplitude detected by the (remote) receiver and interpreted as digital "1s" and "0s".

In the frequency domain, OOK (or DDM) modulation of the RF carrier (theoretically!) results in a double side band / suppressed carrier ("DSB-SC") spectrum; for RC-filtered modulations (the limiting case being sinusoids) only two sidebands corresponding to the sinusoidal modulation frequency appear (see Figure 1). For digital modulations where pulse integrity is high, the fast rise/fall times generate additional ("secondary") sidebands at odd harmonic frequencies of the modulation fundamental frequency as shown in Figure 2. In a practical radio however, some RF carrier leakage is inevitable and the sidebands will be centered about the RF leakage signal as shown in figure 3.

For "instantaneous" observation of the entire spectrum on an average basis, the pseudorandom test pattern of a Bit Error Rate test set can serve as the modulation data input – for this case, the readout from a spectrum analyzer will look like Figure 4 where the many sideband amplitudes follow a $(\text{Sin } x)^2 / x^2$ envelope.

Note that in all cases for OOK modulation, the bandwidth of the primary sidebands (in Hz) is equal to the data rate (in bps), i.e., the bandwidth of either primary sideband for a 1.25 Gbps data rate is 1.25 GHz.

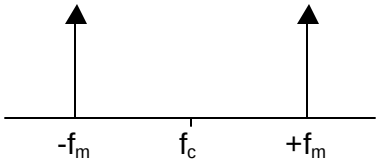

Figure 1 – Sidebands for RC-filtered Square Wave OOK Modulation

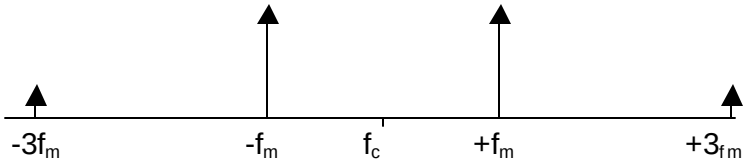

Figure 2 – Sidebands for Fast Rise/Fall time Square Wave OOK Modulation

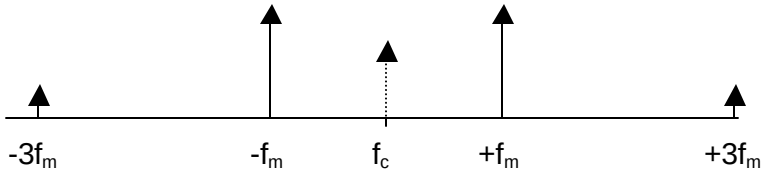

Figure 3 – Sidebands for a Practical Transmitter (showing RF carrier leakage), for Fast Rise/Fall time Square Wave OOK Modulation

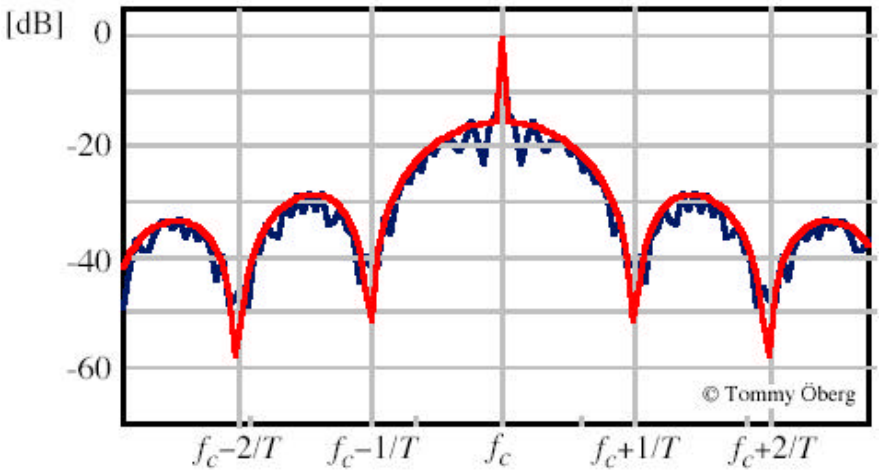

Figure 4 – Modulation Envelope for a Pseudorandom NRZ Test Pattern Providing OOK Modulation