Half-IF Spurious Frequency

An irksome 2nd-order spurious response called the half-IF (1/2 IF) spurious response, is defined for the mixer indices of (m = 2, n = -2) for low-side injection and (m = -2, n = 2) for high-side injection. For low-side injection, the input frequency that creates the half-IF spurious response is located below the desired RF frequency by an amount $f_{IF}/2$ from the desired RF input frequency. The desired RF frequency is 2400MHz, and in combination with the LO frequency of 2200 MHz, the resulting IF frequency is 200MHz. For this example, the *undesired* signal is at 2300 MHz and causes a *half-IF spurious product* at 200MHz. For high-side injection, the input frequency that creates the half-IF spurious response is located *above* (by $f_{IF}/2$) the desired RF.

For example,

assume:

- f_{RF} = 2400 MHz
- f_{LO} = 2200 MHz
- f_{IF} = 200 MHz
- Calculate $f_{Half\text{-}IF} = f_{RF} – f_{IF}/2 = 2300$ MHz

Check:
$2 \times f_{Half\text{-}IF} – 2 \times f_{LO} =$
$2 \times (f_{RF} - f_{IF}/2) - 2 \times (f_{RF} - f_{IF}) =$
$2 \times f_{RF} – 2 \times f_{IF}/2 - 2 \times f_{RF} + 2 \times f_{IF} = f_{IF}$
Results in:
2 × 2300 MHz – 2 × 2200 MHz = 200MHz the IF frequency.

Thus it can be seen that the half IF signal at 2300 Mhz is capable of producing the same IF as the desired signal through the mixer.

IP2 and its relationship to the half IF spurious response:

The relationship between the half IF and the *input* second order intercept point can be expressed as:

½ IF rejection = ½(IP2 – S – CR).

Here,

IP2 = equivalent input second order intercept point at the receiver input (dBm)
S = receiver sensitivity (dBm)
CR* = cochannel rejection (dB)

The assumptions made here are that the mechanism of the half IF generation is internally generated, not fed from outside. It is assumed that only the fundamental RF and LO frequencies are applied to the mixer ports and that the harmonic distortion is created in the mixer alone. Image-reject filters used in the RF path immediately ahead of the mixer attenuate any amplifier harmonics. The noise filter in the LO path attenuates harmonics caused by the LO injection source.

A RF amplifier placed ahead of ther mixer will degrade half IF performance.

* *Cochannel rejection is the S/N ratio at the detector input required for some particular receiver baseband performance such as 12dB SINAD, 20dB T/N, BER etc. This is a critical parameter for receiver design and should be as low as possible. It is basically the IF S/N ratio at the detector input required to meet some baseband specification.*