

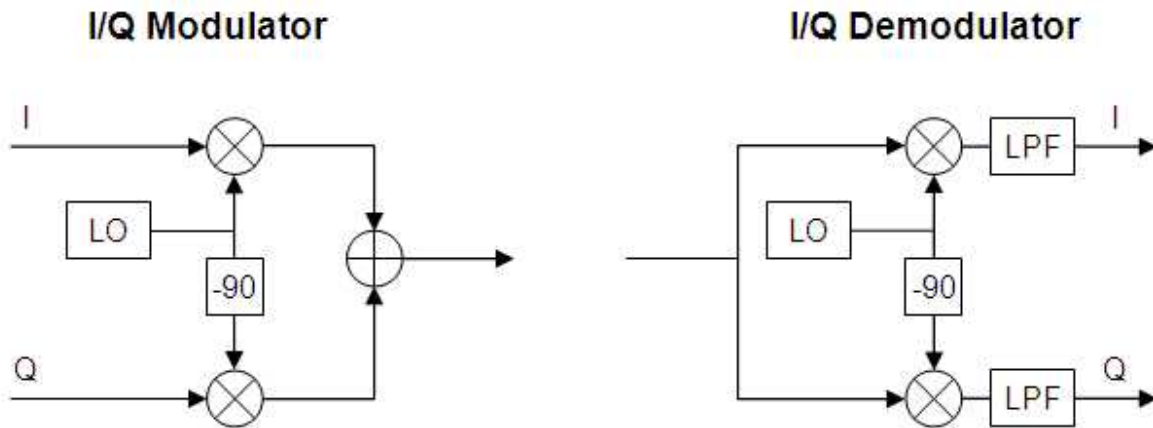
LO Phase Shift for IQ Modulator-Demodulator

Problem

Why, when assembling an I/Q modulator or demodulator using MIXER_B/MIXER_F, is a phase shift of +90 degrees applied to the LO signal rather than -90 degrees?

Solution

In an ideal I/Q modulator or demodulator, the I channel is mixed with $\cos(2f_{LO}t)$, while the Q channel is mixed with $-\sin(2f_{LO}t)$:



Using the identity:

$$\cos(f_{LO}) = \cos(s) \hat{A} \cdot \cos(t) - \sin(s) \hat{A} \cdot \sin(t)$$

We can relate $-\sin(2f_{LO}t)$ to $\cos(2f_{LO}t)$ by:

$$\cos(f_{LO} + \pi/2) = \cos(f_{LO}) \hat{A} \cdot \cos(\pi/2) - \sin(f_{LO}) \hat{A} \cdot \sin(\pi/2) = -\sin(f_{LO})$$

Therefore, applying a 90 degree phase shift to $\cos(2f_{LO}t)$ is identical to $-\sin(2f_{LO}t)$.