ECE145B/ECE218B Homework #2 Winter 2011
Due 1/28/2011 at homework box, 3rd floor

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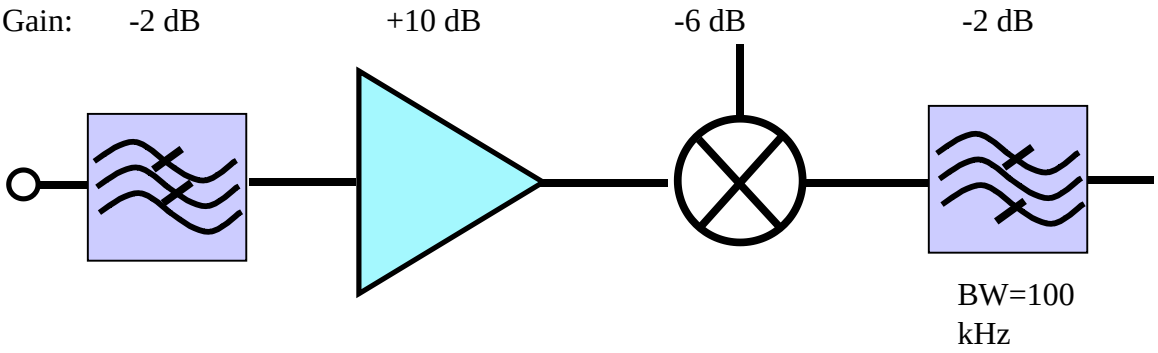
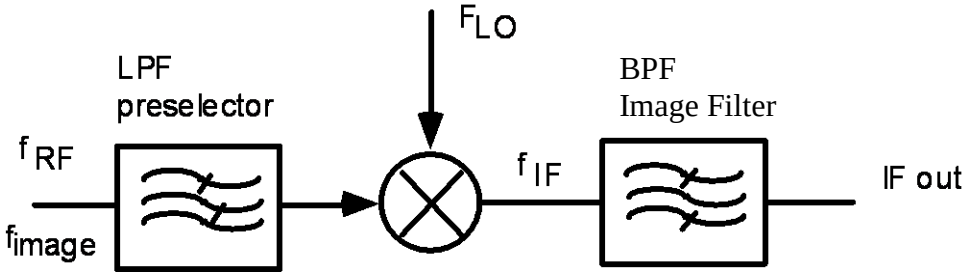
1. A receiver front end that uses a high first IF frequency is an effective tool for improving image rejection while using simple fixed input preselecting filters. But, it does leave the receiver vulnerable to second order IMD.



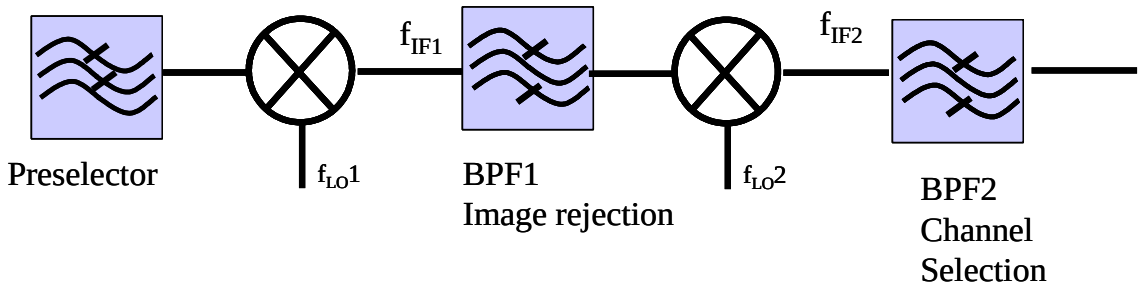
Input Second Order IP:	+10 dBm	+20 dBm
Input Third Order IP:	0	+10
Noise figure:	2 dB	6 dB

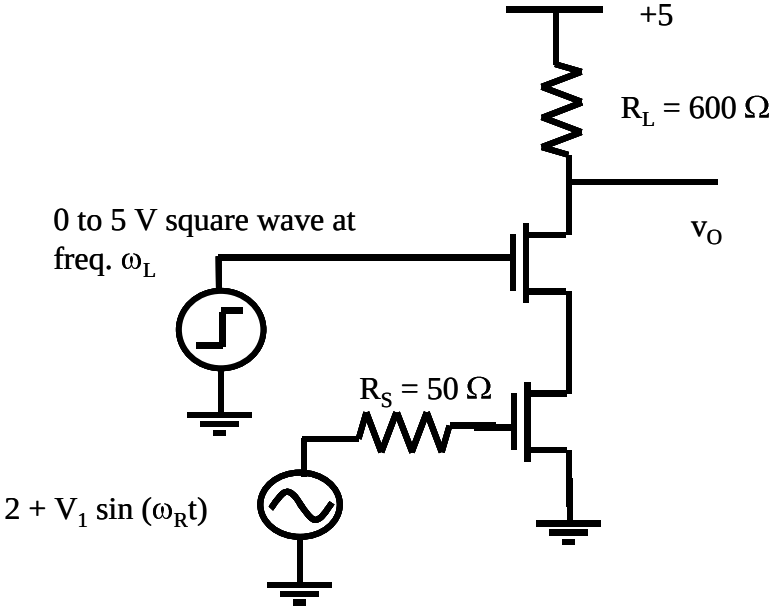
a. Find the second order and third order intercept points at the input of the receiver.
b. Explain why second order IMD could be a problem with this design.
c. There will be an input signal power level where the second and third order distortion powers are equal. Determine this level and note the region where the second order distortion dominates.
d. Assume two signals are applied to the input with equal power. What power will be necessary to produce second and third order IMD products with power just equal to the minimum detectable signal?

2. Consider the receiver front end below. You are to determine f_{IF} and f_{LO} such that the image rejection for the FM broadcast band will be at least 30 dB. The minimum RF frequency is 88 MHz and maximum is 108 MHz. The preselector low pass filter has a cutoff frequency of 108 MHz and has a 40 dB/decade slope after cutoff.



b. Now add a second mixer with a 10.7 MHz channel selection IF filter at the output. Specify the Image Filter bandwidth needed to suppress the image at the output of mixer 1 by 30 dB. Assume BPF1 has a 3 to 60 dB bandwidth ratio of 5. Also specify f_{LO2}.





3.a. The circuit above operates as a mixer. M1 is biased in saturation (active region) when the LO switch is on. You can assume that the RF input amplitude V_1 is small and that the LO input fully switches the upper MOSFET. Consider products up to the second order. Derive the conversion gain and DC, LO or RF feedthrough components, if any.

b. Using the device characteristics shown, and assuming V_1 = 0.1V, calculate the IF output power.