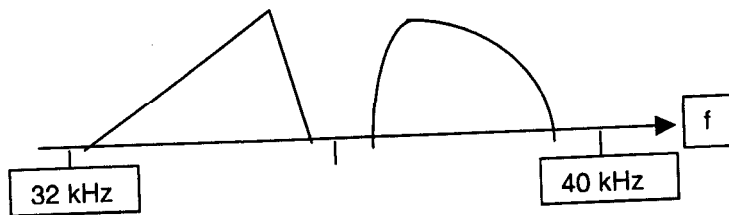


83080 Receiver Architectures and Synchronisation in Digital Communications
Exam 12.3.2001

Answers in Finnish, Swedish, or English!

1. Describe the principle of superheterodyne receiver. What are the requirements for the RF filter and IF filters? Advantages/disadvantages of this receiver principle, considering also possibilities for highly integrated solutions? Describe also the principle of image-reject mixer, i.e., how quadrature mixing helps in providing the image rejection in a superheterodyne receiver. What are the practical limitations of this approach?
2. In a radio system, blocking requirements are specified in the following way: Interfering tone has no modulation and its offset from wanted signal carrier is 1 MHz. Wanted signal power is -100 dBm and interfering tone power is -30 dBm. 10 dB S/N ratio (or signal/interference ratio) is needed for detection. Then what is the required phase noise in the receiver local oscillator, if the system noise bandwidth is 200 kHz? Assume that phase noise is flat at the given offset and that there are no other noise or interference sources.
3. The figure shows the spectrum of a real bandpass signal (only positive frequencies shown). Show the resulting spectrum after (a) real bandpass sampling (b) quadrature bandpass sampling, both at the rate of 8 kHz.



4. Describe the main ideas of maximum likelihood estimation theory in carrier/symbol timing recovery.

5a and 5b are alternatives, please answer only one of them!

5a. What is characteristic to the all-digital synchronisation concept? What advantages and disadvantages does it have? Describe also the principle of polynomial interpolation and Farrow structure.

5b. Which factors determine the dynamic range of a low-noise amplifier stage? Why the third-order intermodulation distortion is an important consideration in receivers? What kind of interference and how it may produce? What is IP3? In which cases the second-order intermodulation becomes a problem?

Feedback about the course is greatly appreciated!
Please use the web-based evaluation system, instructions on the web-page of the course.