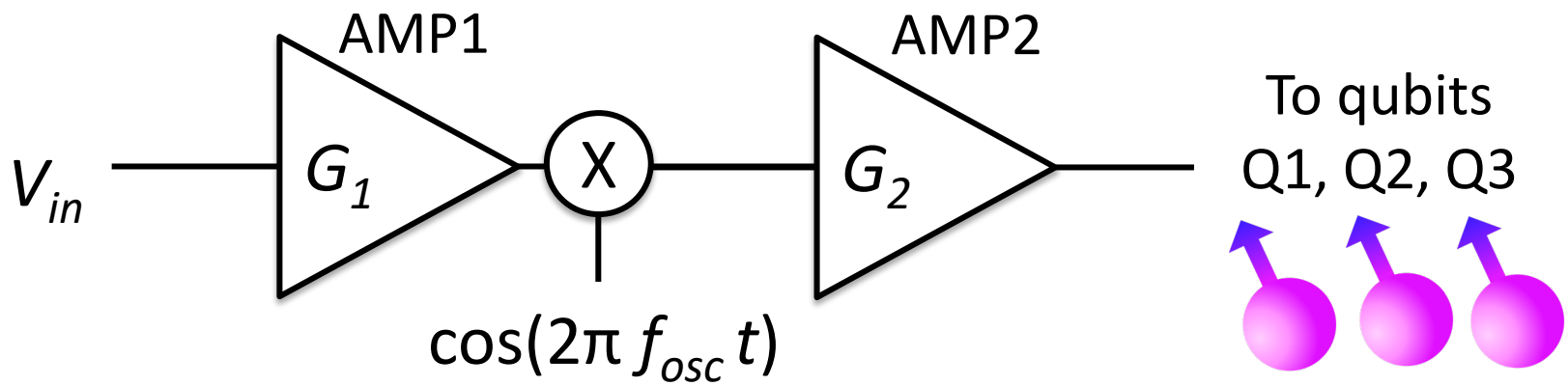
EE4575 – 2022/2023

Assignment 4

Assignment 4 (1/3)



- 3 qubits (Q1, Q2, Q3)
  - Larmor frequencies: f1=11 GHz, f2=12 GHz, f3=13 GHz
  - Rabi frequency for all qubits: fR = 1 MHz
- G_1=200, G_2=1
- f_{osc} = 10 GHz

Assignment 4 (2/3)

A. Start from the example in the file HW4A_example.m demonstrating a pi rotation around the X axis of Q1 for an ideal system.
   1. While keeping the same driving for Q1, determine the maximum 2nd and 3rd order distortion of AMP1 to maintain a fidelity above 99.9% in the idle operation, i.e. identity operation, on Q2 and Q3. Show how you derived your answer and explain. **[3 points]**
   2. With the system found in A1 (including non-linearity in AMP1), can 2nd or 3rd order non-linearity in AMP2 affect the fidelity of Q2 and Q3? Explain and demonstrate by simulation. **[3 points]**
   3. Change the parameters to only have distortion in AMP1. Do the introduced non-linearities affect the fidelity in the pi-rotation of Q1? If yes, how can you compensate for it? If not, why? Explain and demonstrate by simulation. **[1 point]**

Assignment 4 (3/3)

B. Generate an input signal to drive a pi-rotation around the X axis for *both* Q1 and Q2.
   1. Find the nonlinear coefficients for AMP1 and AMP2 such that the fidelity of Q3 is above 99.9%. Divide the infidelity evenly over the two amplifiers. **[1 point]**
   2. Do the constraints on the non-linearity of AMP2 change with respect to point A.2? How? (and why?) *Explain and demonstrate by simulation.*

      [2 points]

Submission of the answers

- Make a **.zip** archive containing
  - A readable **.pdf** with the answers to the questions
  - The corresponding **.m** files
  - spine.m and fidelity.m

- Make a new **.m** file for **every** (sub)question (don't put the code from all assignments in a single file)
- Make sure your code is **readable** and add **comments**

- Name your **.pdf** and **.zip** according to: *lastname_HWx.pdf(zip)* with *lastname* the last name of the student that submits the answers on Brightspace