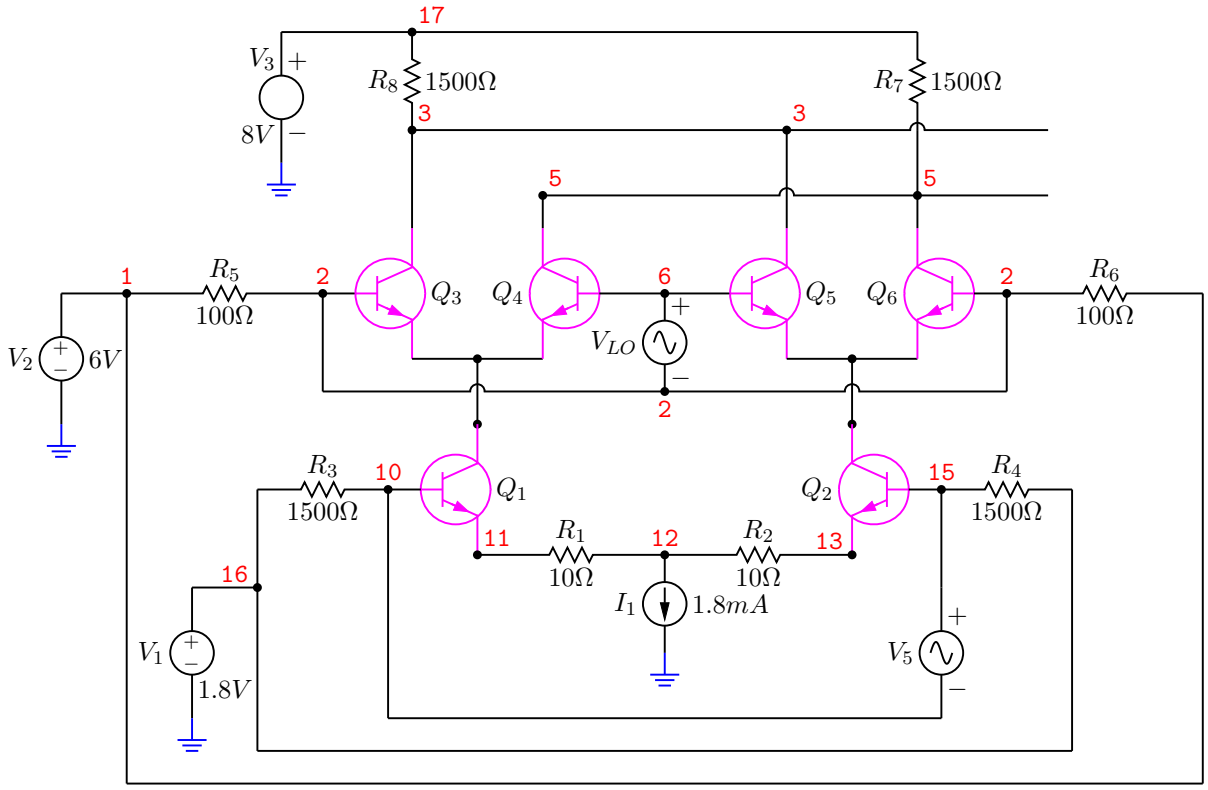

Figure 1: Gilbert Cell Mixer. The netlist is given in figure 2, and has previously appeared in figure 7.7 of [1]. There are many possible variations, and the original Gilbert cell reference is [2]. In this version, the LO voltage is given by `v(6,2)` and `v(15,10)` is the input. The output is the difference between collector voltages of Q4/Q6 and Q3/Q5 (`V(5,3)`), and should be the approximate product of the LO and input voltages.

References

[1] Eric R. Keiter, Thomas V. Russo, Eric L. Rankin, Richard L. Schiek, Heidi K. Thornquist, Deborah A. Fixel, Todd S. Coffey, Roger P. Pawlowski, Keith R. Santarelli, and Christina E. Warrender. Xyce parallel electronic simulator: User's guide, version 5.2. Technical Report SAND2011-2515, Sandia National Laboratories, Albuquerque, NM, 2011.

[2] B. Gilbert. A precise four-quadrant multiplier with subnanosecond response. *IEEE Journal of Solid-State Circuits*, 3(4):365–373, Dec 1968.

```
* A gilbert cell mixer
R5 1 2 100
Q3 3 2 4 DEFAULTS
Q4 5 6 4 DEFAULTS
Q5 3 6 8 DEFAULTS
Q6 5 2 8 DEFAULTS
R6 2 1 100
*the local oscillator
VLO 6 2 DC 0 SIN(0 .05V 4e6 0 0)
Q1 4 10 11 DEFAULTS
R1 11 12 10
R2 12 13 10
* input bias current
I1 12 0 DC 1.8mA
Q2 8 15 13 DEFAULTS
R4 15 16 1500
R3 16 10 1500
V1 16 0 DC 1.8V
*the input voltage to be mixed with the LO
V5 15 10 DC 0 sin(0 .05V 3e6 0 0)
R7 5 17 1500
R8 3 17 1500
V3 17 0 DC 8V
V2 1 0 DC 6V
.MODEL DEFAULTS NPN

.TRAN 1ns 1us
.PRINT TRAN v(6,2) v(15,10) v(5,3)

.SENS objfunc=v(5) param=DEFAULTS:IS
.options sensitivity adjoint=0 direct=1
.print SENS format=tecplot v(5)
.end
```

Figure 2: Gilbert Cell Mixer netlist