PSpice simulation of two phase CCD array.

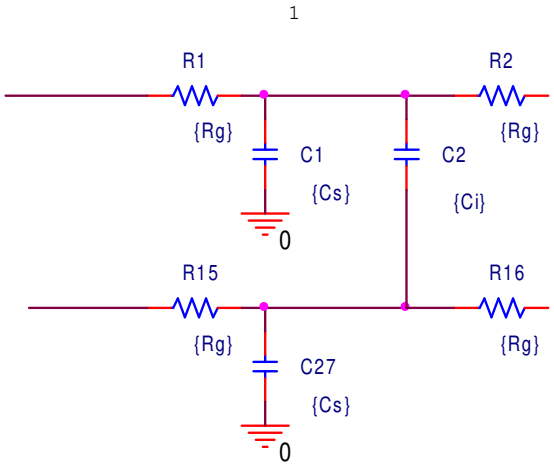
Following the work on modeling the three phase CCD array detailed in the previous note (JET-LCFI-CCD-001), the work is extended to a two phase array with sinusoidal voltage waveforms.

The values of Rb, Rc, Ci and Cs are modified slightly as each gate will occupy 50% more surface area on the CCD due to there being only two phases instead of three.

Simple 1-d model

In this model, the bus line resistance running "vertically" along the sides of the CCD is assumed to be zero. Thus, the voltage profile is not dependent upon the y (vertical) dimension but only upon the x (horizontal). The CCD can be modeled using just 13 elements each representing an area 1 mm by 100 mm of the CCD surface. The parameter values used in this simulation are as follows:

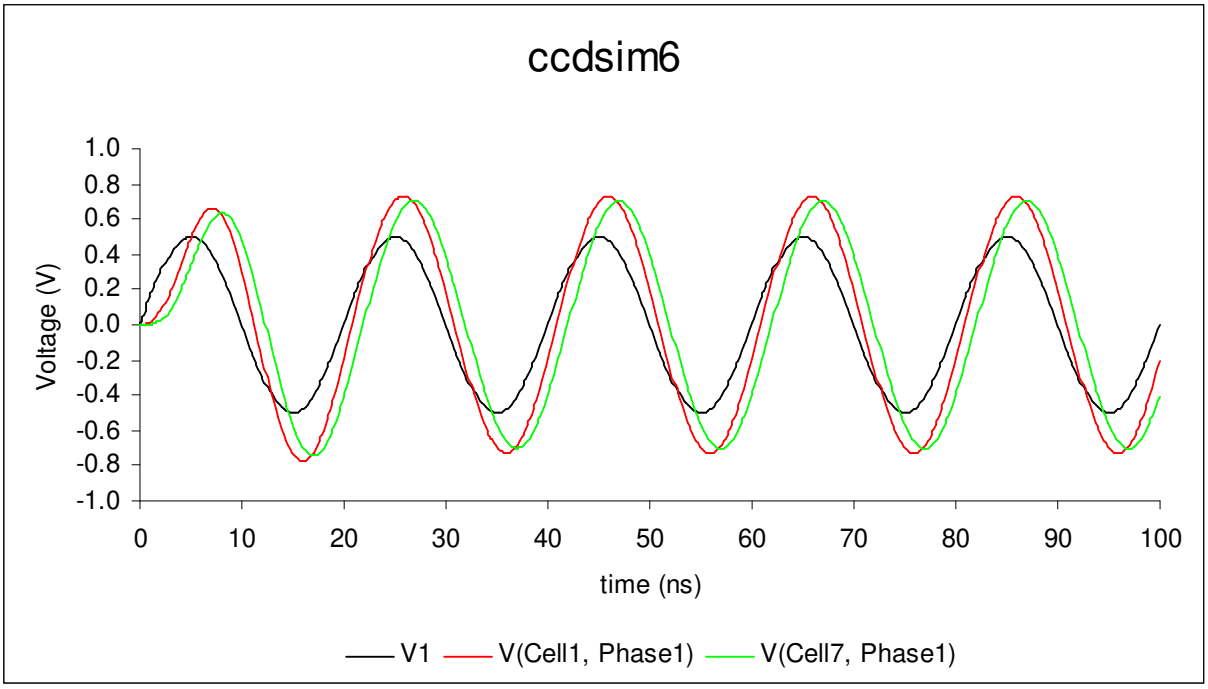
Rg: 0.04 Ohms
Cs: 500pF
Ci: 250pF x 2 (This capacitance will exist either side of the phase line to the adjacent line, so the capacitance between the two is effectively double the single phase to phase capacitance.)
Ld: 200 pH



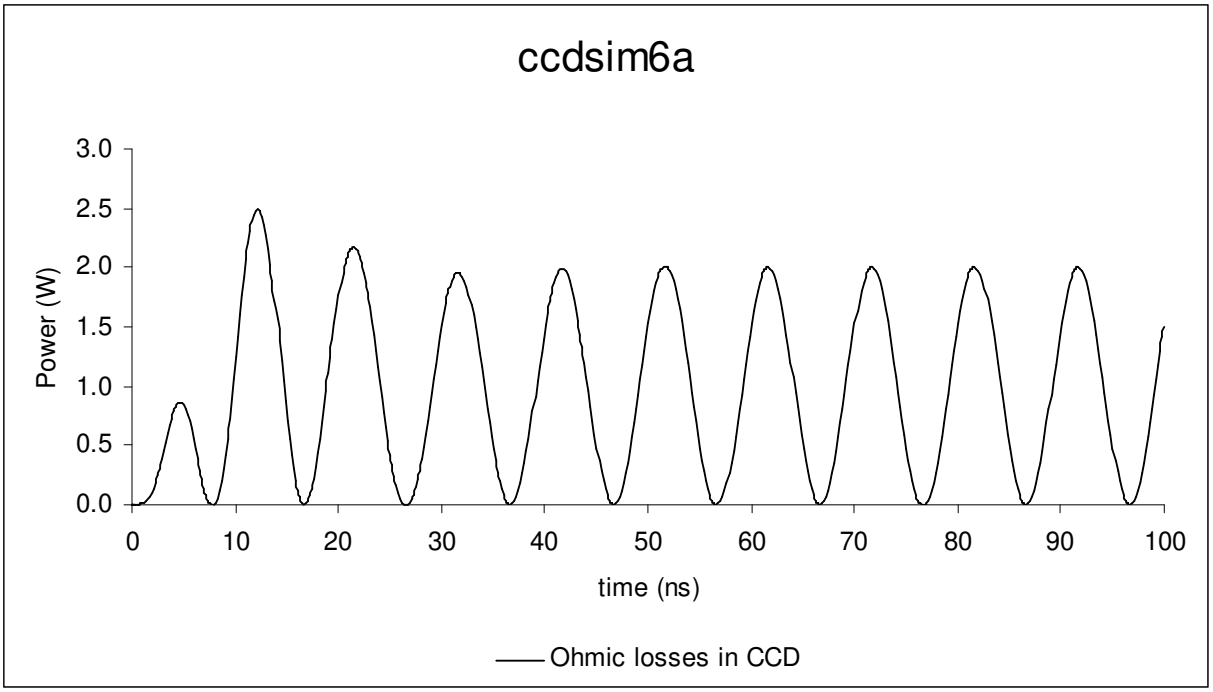
A single element showing the gate resistances, substrate capacitances and interphase capacitance.

A 50Mz sinusoidal voltage was used as the drive supply. The voltage swing was 1V.

Results: CCDsim6.xls



These results show the voltage profile at the edge and in the middle of the CCD assuming that the resistance Rb is negligible. During the voltage cycle, energy is stored by the capacitances and the inductances and is dissipated through the resistors. The actual ohmic losses in the resistors has been obtained and is shown below.



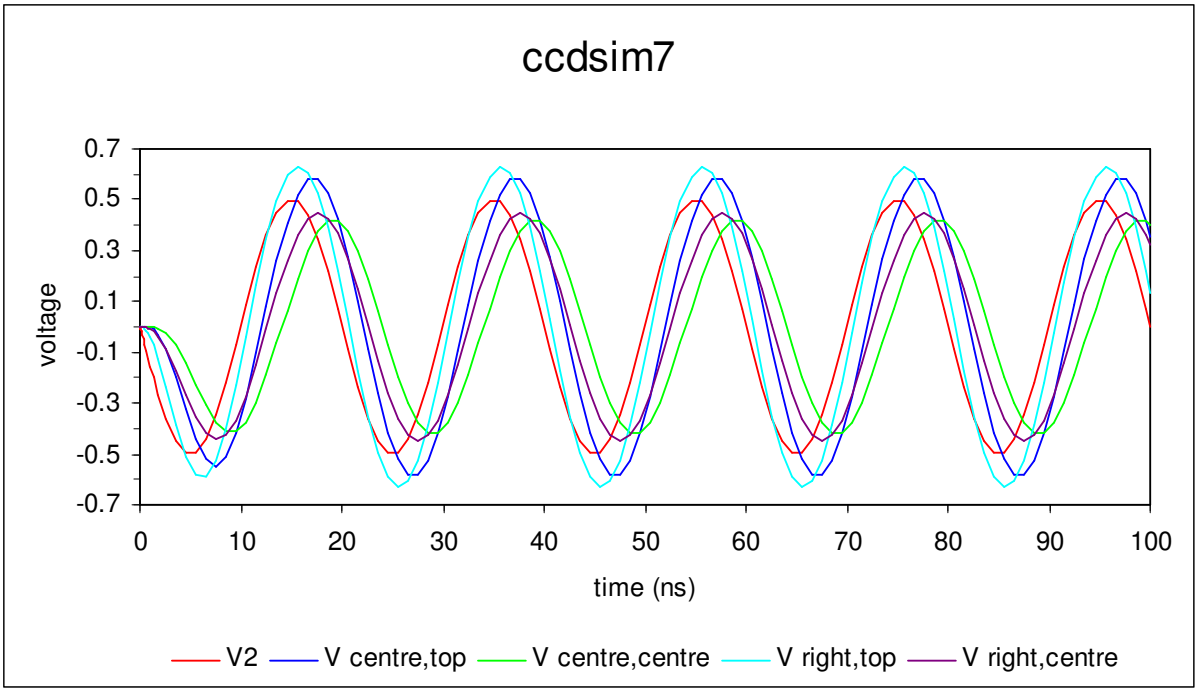
Realistic value of Rb.

When we introduce a realistic value of Rb, the following results are obtained for the voltage profile in the right-top, centre-top, right-centre and centre-centre points on the CCD.

The following parameters are used. (They refer to a 1mm by 10mm section of CCD rather than a 1mm by 100mm section as the previous case)

Ld: 200 pH
Rg: 0.4 Ohms.
Cs: 50 pF
Ci: 25 pF
Rb: 0.27 Ohms

Results: CCDsim7.xls



Justin Edward Theed
RAL R63 G22
Ext 5369