ABSTRACT

A semiconductor device includes gate electrodes extending in a first direction, first and second vertical structures passing through the gate electrodes, first and second upper interconnection structures, the first and second vertical structures including a back gate electrode, a ferroelectric material layer, a channel layer, and a gate insulating layer, the first upper interconnection structure including bit lines extending in a second direction, a first contact plug connected to a lower surface of a first back gate electrode of the first vertical structure, and a first back gate interconnection extending between the bit lines in the second direction and connected to the first contact plug, and the second upper interconnection structure including a second contact plug connected to an upper surface of a second back gate electrode of the second vertical structure, and a second back gate interconnection extending in the second direction and connected to the second contact plug.

FIG. 4