

(12) **United States Patent**
Kim et al.

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(54) **INTEGRATED CIRCUIT DEVICES HAVING METASTABILITY PROTECTION CIRCUITS THEREIN**

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(*) Notice: Under 35 U.S.C. 154(b), the term of this patent shall be extended for 0 days.

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(30) **Foreign Application Priority Data**

May 29, 1998 (KR) 98-19805

(51) **Int. Cl.⁷** **H03K 17/16**

(52) **U.S. Cl.** **326/21; 326/26; 327/198**

(58) **Field of Search** **326/21, 26-27, 326/9, 13, 94, 83, 86; 327/53, 198, 312, 321, 328**

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(57) **ABSTRACT**

Integrated circuit devices having metastability protection circuits therein include a main active circuit and a metastability detection/prevention circuit. The main active circuit may comprise a comparator, a sense amplifier, a differential amplifier or a voltage generating circuit, for example. The metastability detection/prevention circuit performs the function of detecting whether an output of the main active circuit has been disposed in a metastable state for a duration in excess of a transition duration. The output of the main active circuit may be considered as being in a metastable state if a potential of the output signal equals V_{MS} , where V_{MS} is in a range between V_{IL} and V_{IH} . If the output signal has been in a metastable state for a duration in excess of the transition duration, then the metastability detection/prevention circuit will generate a control signal at a designated logic level. This control signal is provided as an input to the main active circuit and causes the output of the main active circuit to be driven out of the metastable state (i.e., to a logic 1 or 0 level). In this manner, prolonged metastability can be prevented even if the values of the input signals to the main active circuit would otherwise dispose the output in a metastable state.

13 Claims, 4 Drawing Sheets

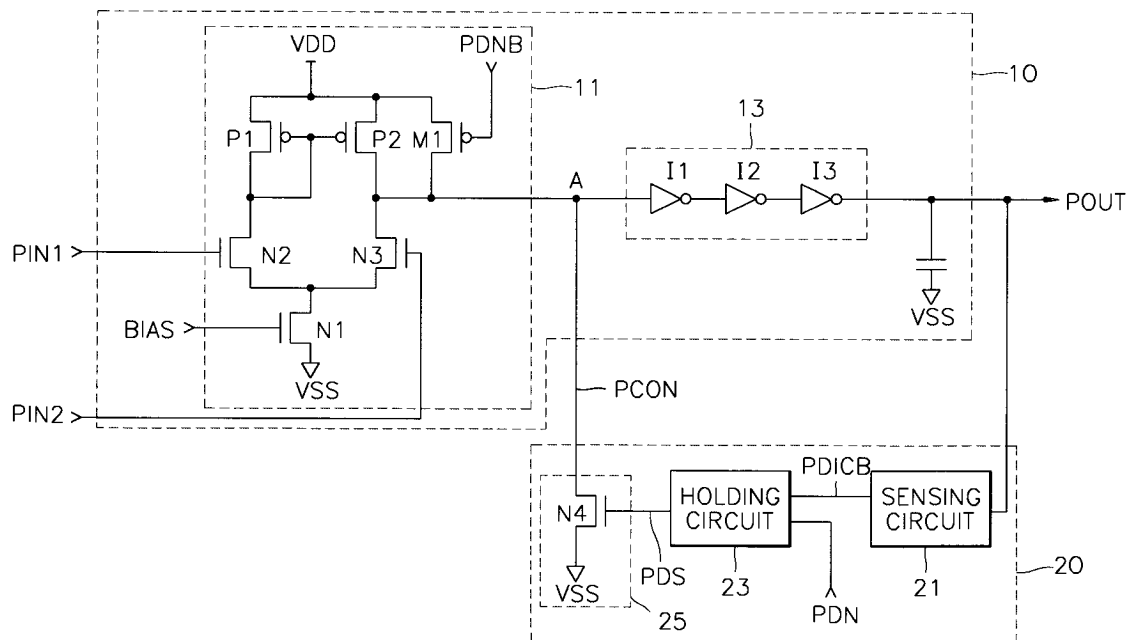


FIG. 1

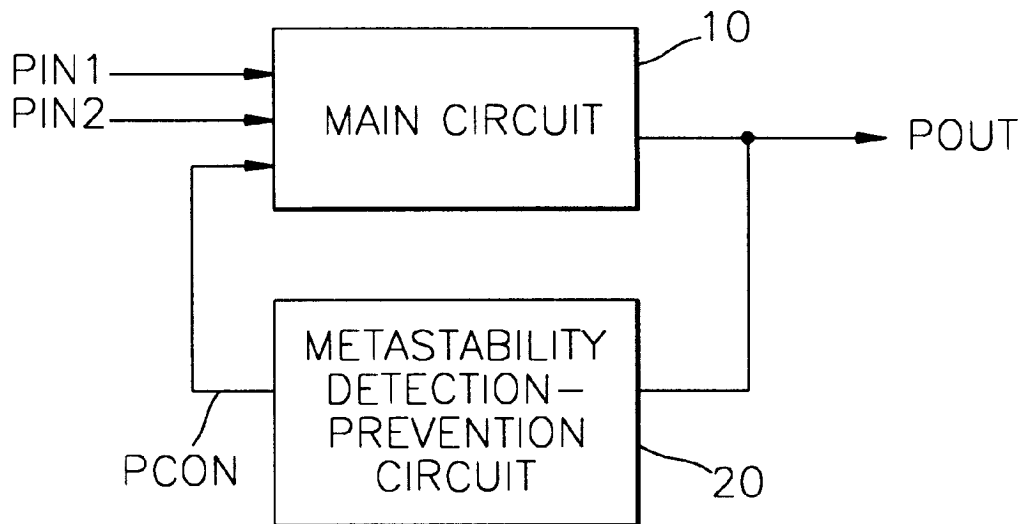


FIG. 2

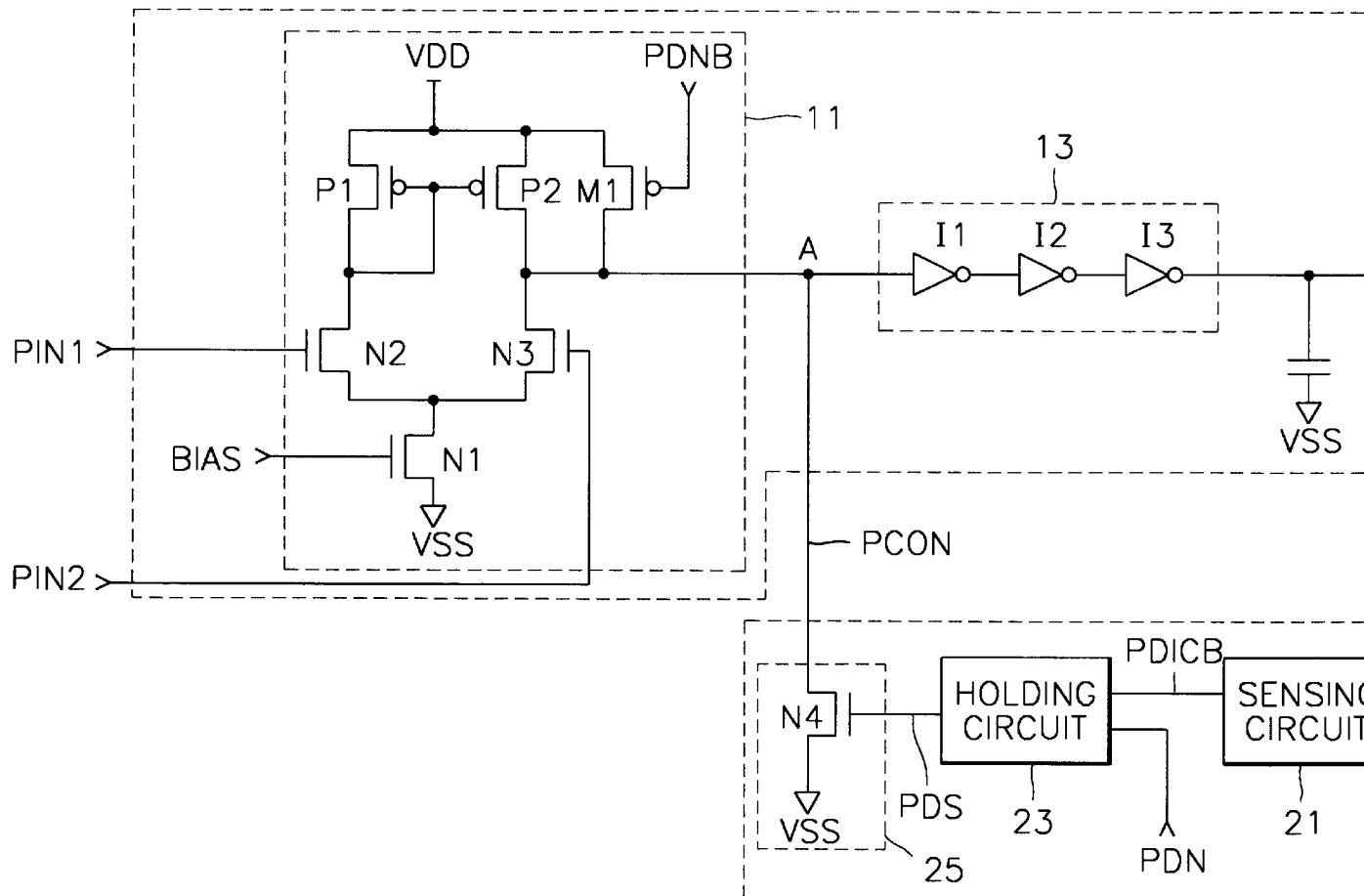


FIG. 3

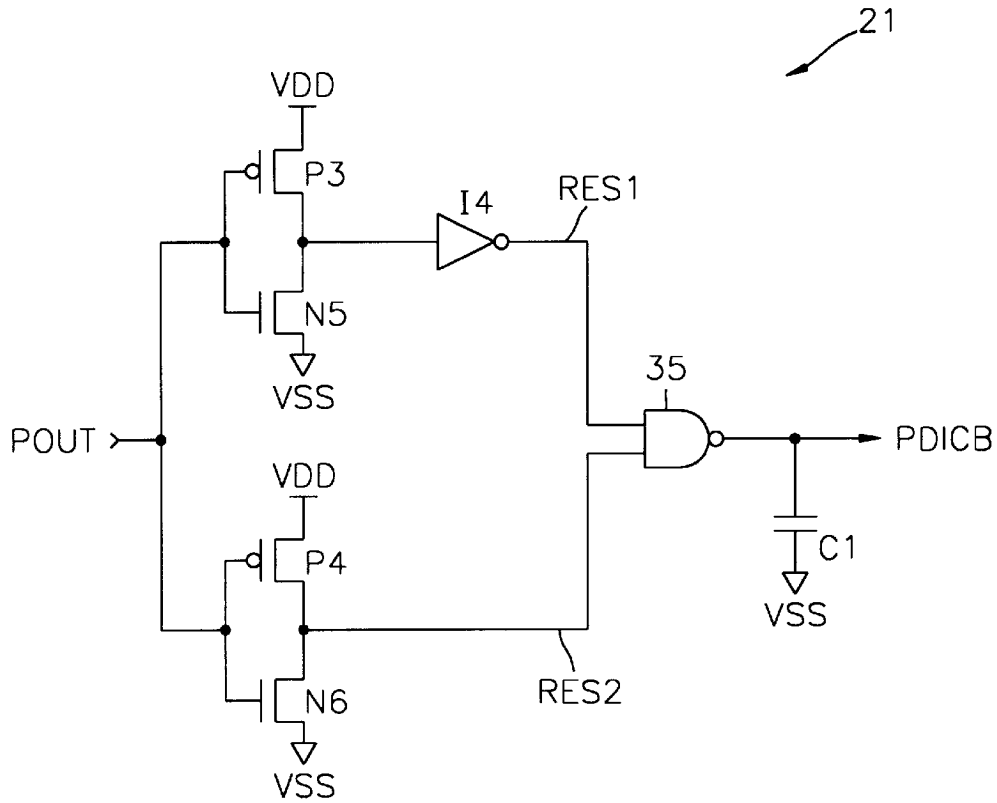


FIG. 4

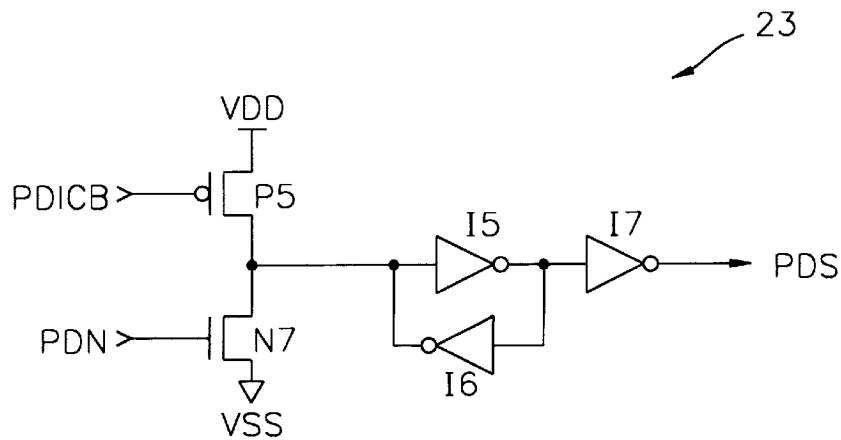
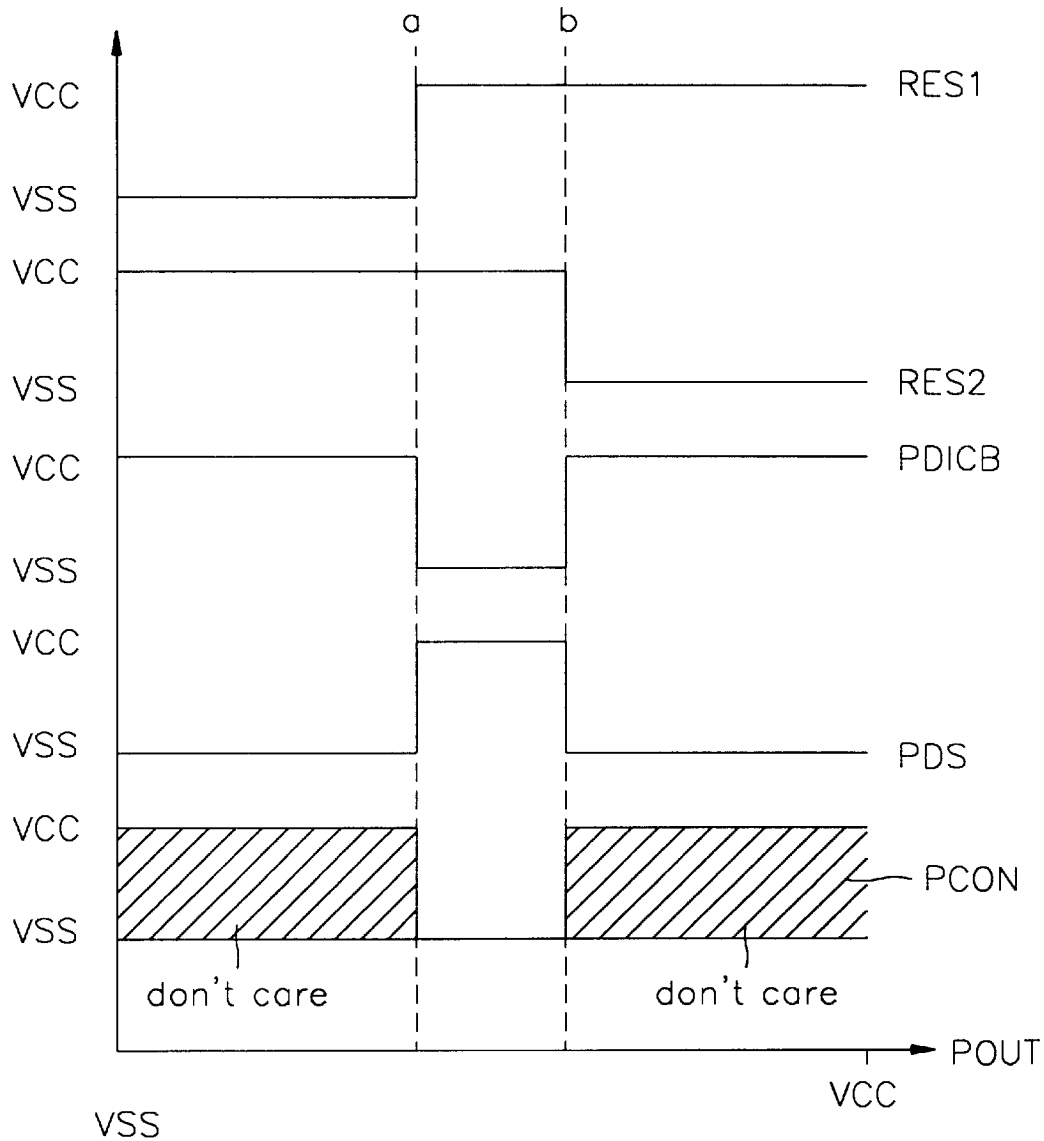


FIG. 5



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