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# United States Patent [19]

[11] Patent Number: **6,034,563**

Mashiko

[45] Date of Patent: **\*Mar. 7, 2000**

[54] **SEMICONDUCTOR INTEGRATED CIRCUIT HAVING REDUCED CURRENT LEAKAGE AND HIGH SPEED**

### FOREIGN PATENT DOCUMENTS

|           |         |                      |         |
|-----------|---------|----------------------|---------|
| 0 690 510 | 1/1996  | European Pat. Off. . |         |
| 1-289137  | 11/1989 | Japan .....          | 327/544 |
| 5-48424   | 2/1993  | Japan .....          | 327/544 |
| 6-29834   | 2/1994  | Japan .              |         |
| 7-212217  | 8/1995  | Japan .              |         |

[75] Inventor: **Koichiro Mashiko**, Tokyo, Japan

[73] Assignee: **Mitsubishi Denki Kabushiki Kaisha**, Tokyo, Japan

### OTHER PUBLICATIONS

[\*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

*MTC MOS Logic Circuit Technology*, "Intention of Decreasing the Electric Power Consumption for LSI—1 V. Small Power Consumption High-speed Operation", Densi-Gijutsu (Electronics Technology) 1994-9, pp. 29-32.

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*Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

[21] Appl. No.: **08/651,588**

[22] Filed: **May 22, 1996**

### [57] ABSTRACT

### [30] Foreign Application Priority Data

Oct. 19, 1995 [JP] Japan ..... 7-271574

A semiconductor integrated circuit including a first MOS transistor supplied with a first power supply voltage and having a high threshold voltage; a second MOS transistor supplied with a second power supply voltage and having the high threshold voltage; a logic circuit connected between the first transistor and the second transistor and including a plurality of MOS transistors having a low threshold voltage; a control circuit for generating a control signal when the logic circuit is in a standby state; and a voltage generating circuit for generating a first voltage which is a higher than the first power supply voltage and a second voltage which is a lower than the second power supply voltage, for supplying the first voltage to a gate of the first MOS transistor and for supplying the second voltage to a gate of the second MOS transistor when the logic circuit is in the standby state, thereby to decrease leakage current through the first and second transistors and through the logic circuit when in the standby state.

[51] Int. Cl.<sup>7</sup> ..... **G05F 1/10**

[52] U.S. Cl. .... **327/544; 327/377**

[58] Field of Search ..... 327/390, 589, 327/377, 170, 108-112, 544; 326/88, 80, 81

### [56] References Cited

#### U.S. PATENT DOCUMENTS

|           |         |                      |         |
|-----------|---------|----------------------|---------|
| 4,904,885 | 2/1990  | Yamada et al. ....   | 327/536 |
| 5,041,739 | 8/1991  | Goto .....           | 327/536 |
| 5,128,560 | 7/1992  | Chern et al. ....    | 326/81  |
| 5,159,214 | 10/1992 | Okumura .....        | 326/110 |
| 5,321,324 | 6/1994  | Hardee et al. ....   | 326/80  |
| 5,461,338 | 10/1995 | Hirayama et al. .... | 327/534 |
| 5,528,173 | 6/1996  | Merritt et al. ....  | 326/81  |

**34 Claims, 11 Drawing Sheets**

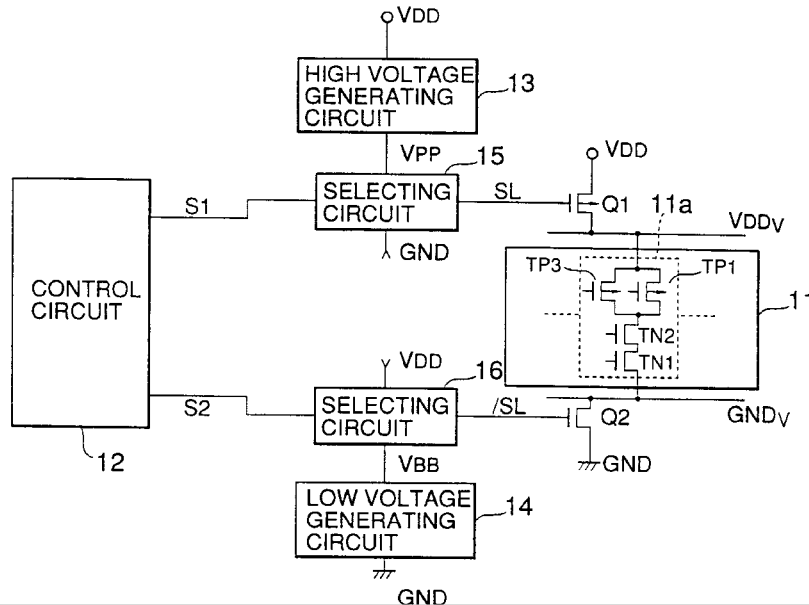


FIG. 1

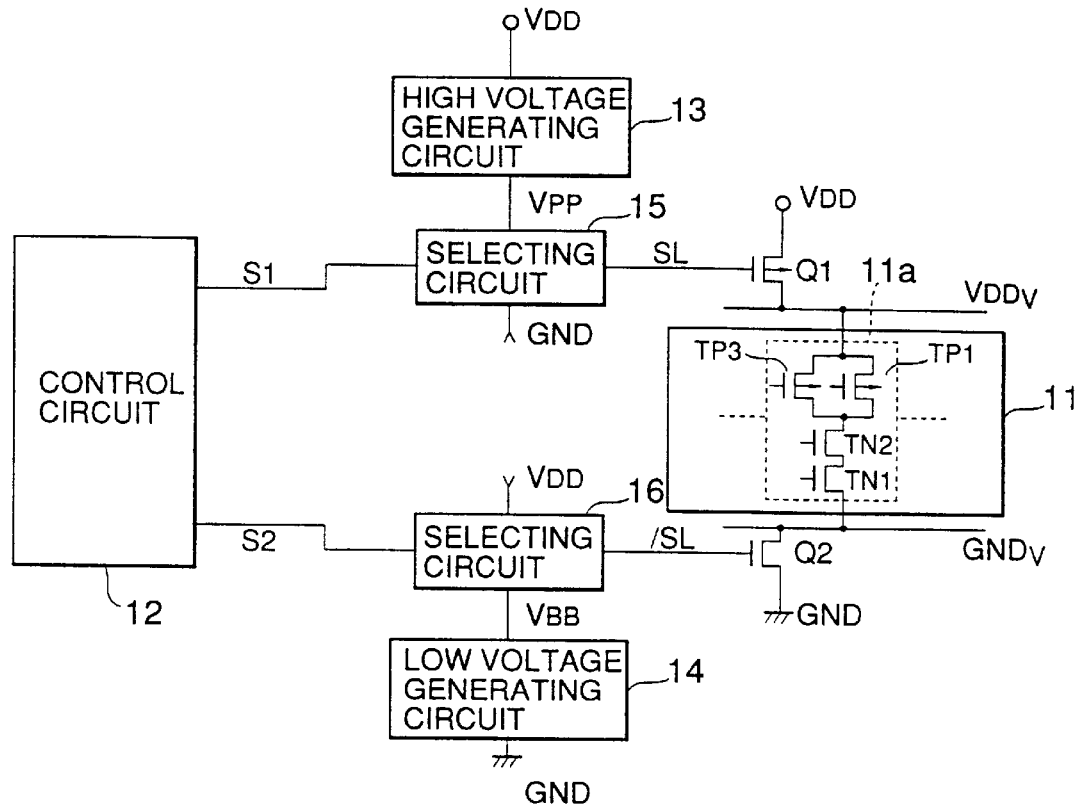


FIG. 2

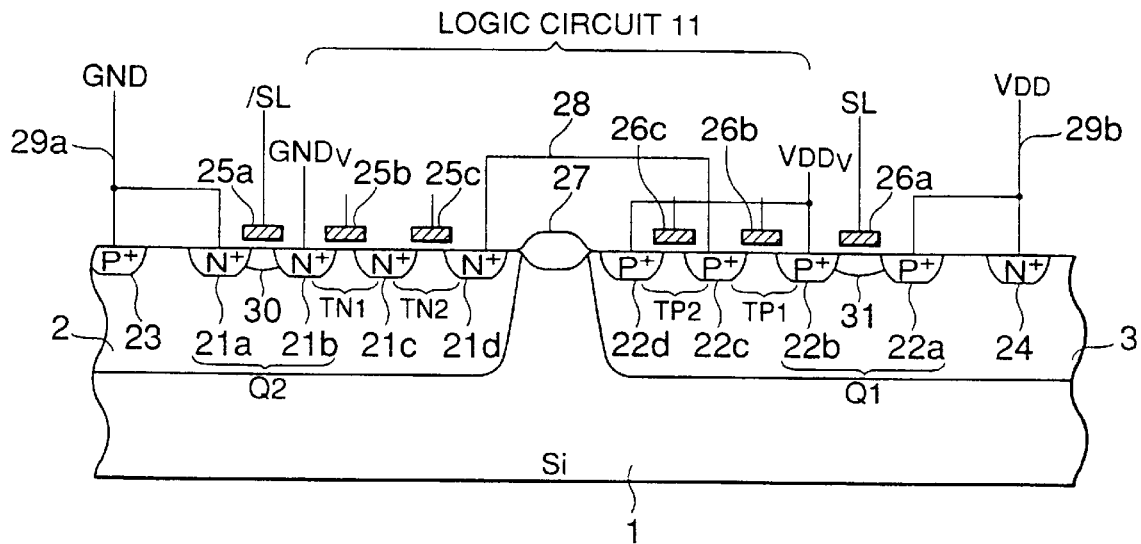


FIG.3

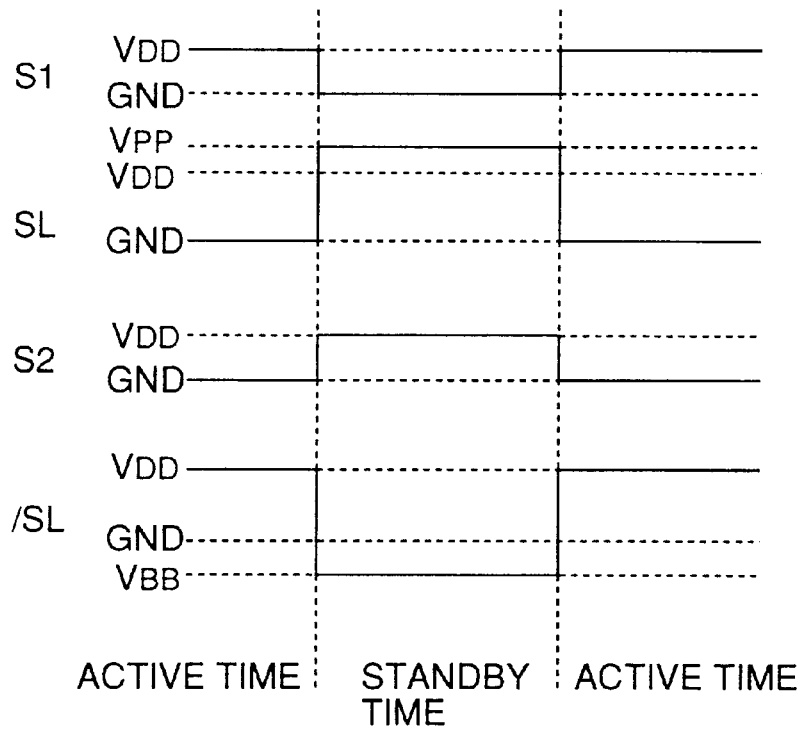


FIG.4

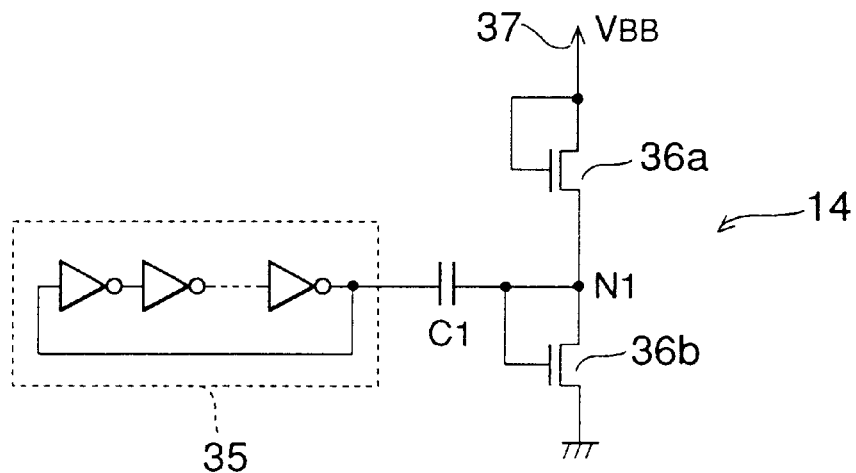


FIG.5

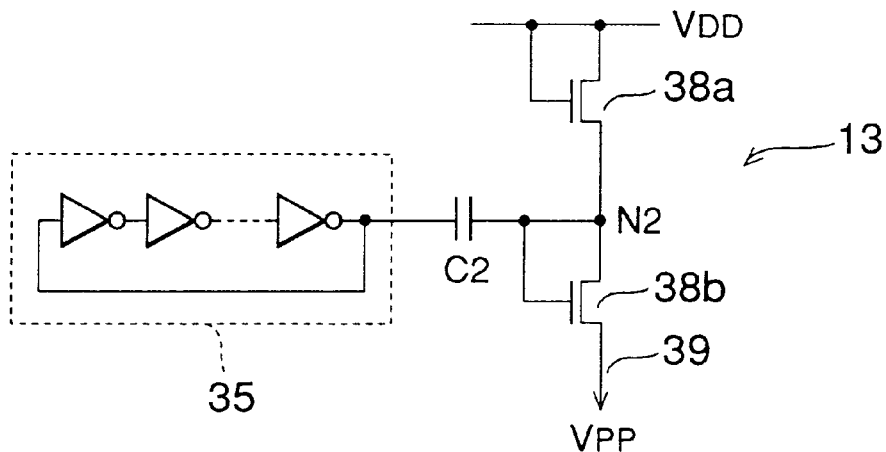


FIG.6

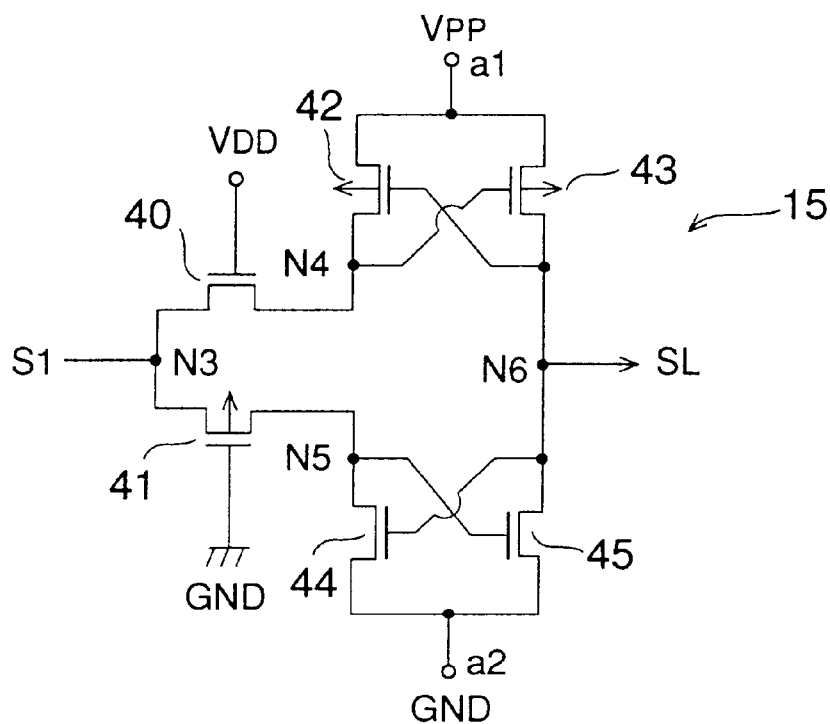


FIG.7

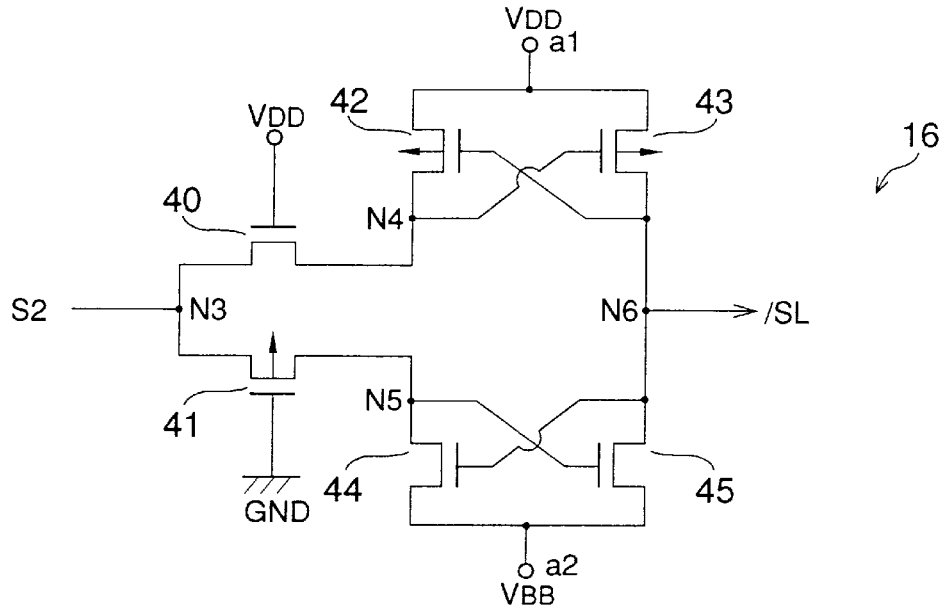
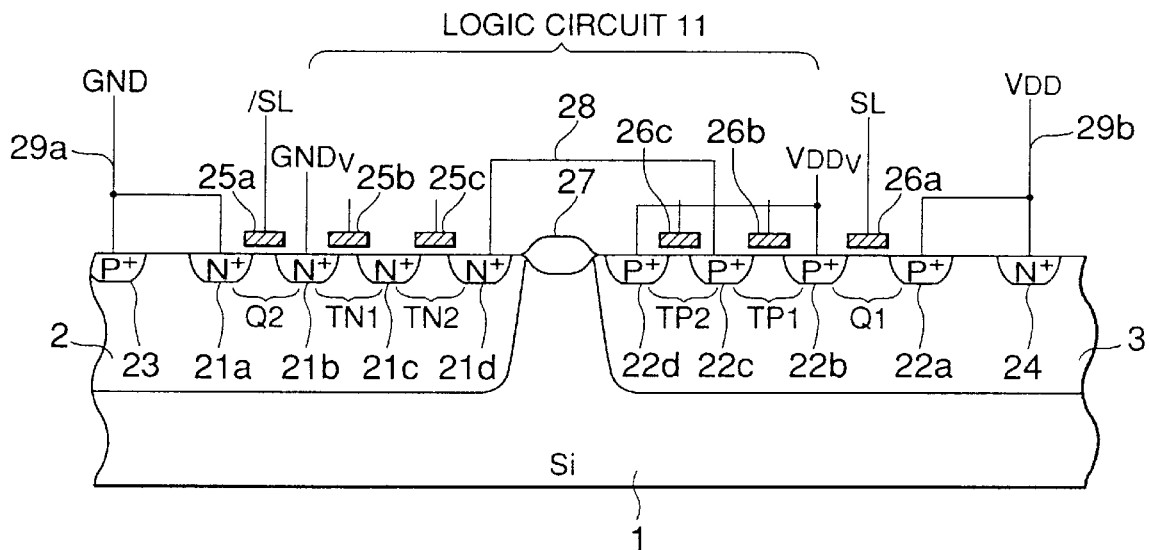


FIG.8



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