

Invalidation of a semiconductor patent

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Complementary logic input parallel (CLIP) field effect transistor (FET) logic circuit

Problems and solutions in the prior art

Problem

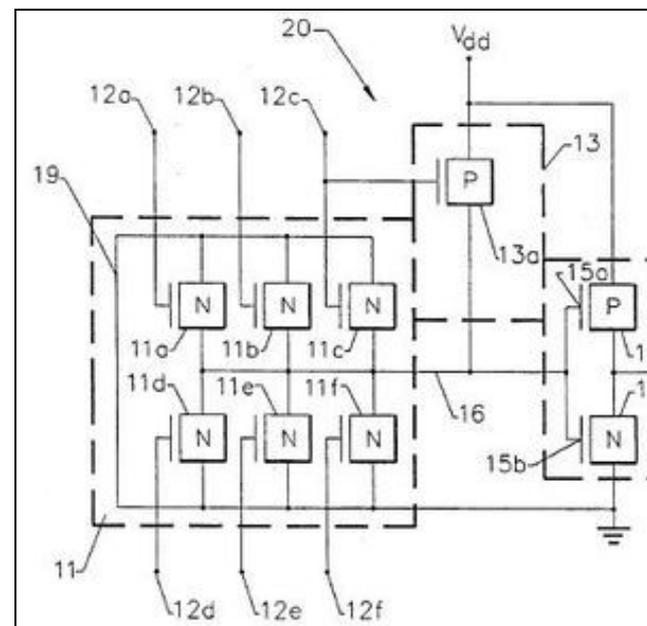
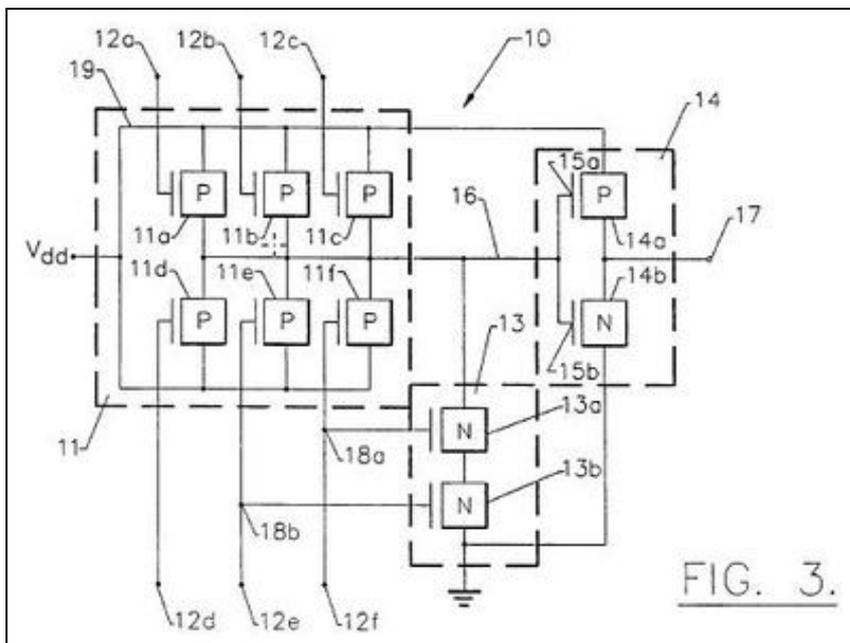
- Serial connection of the load transistors in conventional CMOS logic gates reduces the toggle rate or switching speed of the gate and also reduces the number of inputs which may be applied to the gate (referred to as "fan-in").

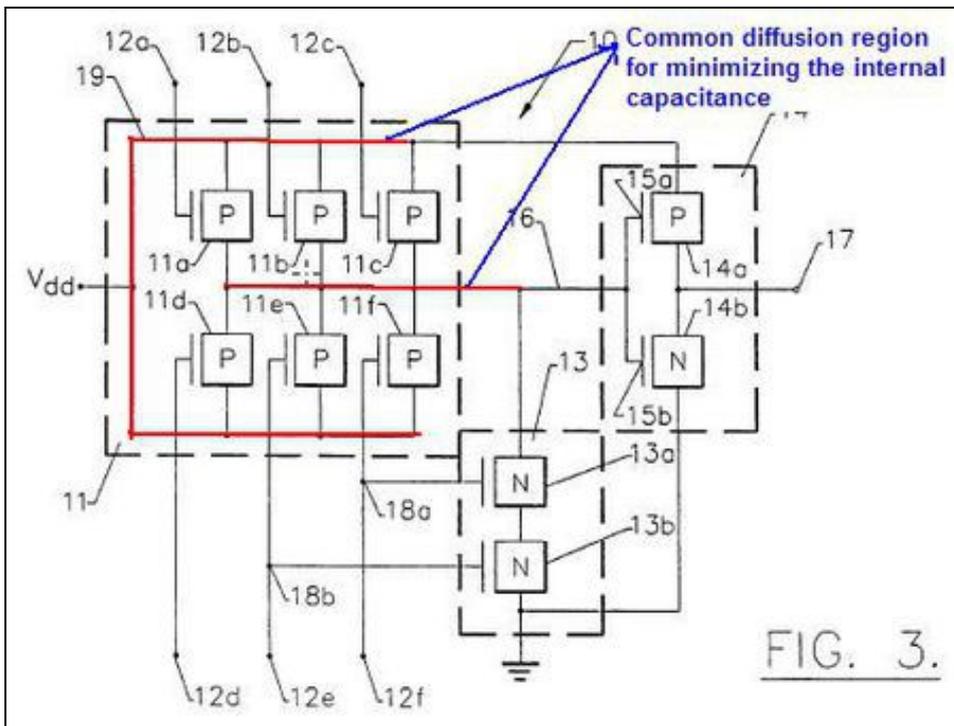
Solutions

- To overcome these problems an "all parallel" CMOS gate design has heretofore been proposed. Here serial load transistors are replaced by a first load which may be an MOS transistor or a resistor, and a second load comprising an MOS transistor having opposite conductivity type from the driver stage transistors.
- A high speed, high density low power dissipation complementary FET logic circuit is disclosed, in which the voltage transfer function of the logic gate's complementary FET inverter output stage is deliberately skewed to dramatically decrease the lift-off interval for the logic gate and thereby dramatically increase the speed of the gate

Problems and solutions for the present invention (CLIP AND & OR logic circuits)

CLIP AND & OR logic circuits according to the invention





- Internal capacitance of the logic gate also is a major roadblock in increasing its speed. The internal capacitance of the gate also typically limits the number of logic inputs which can be handled by a single gate

Solution

- Provide a high speed complementary all-parallel FET logic family which exhibits low internal capacitance so that large numbers of logic inputs may be handled by a single gate.
- Internal capacitance of the CLIP logic circuits is decreased by using common diffusion regions in the integrated circuit, for pairs of driving stage transistors. The use of the common diffusion region between pairs of FET driving transistors reduces the capacitive loading of the common output by a factor of two thereby further increasing the switching speed of the CLIP logic circuits
- Shared diffusion technique may be used for any all-parallel logic circuit to reduce diffusion capacitance by a factor of two

Other circuits

Clocked CLIP Logic Gates

- In the clocked AND gate, the output 17 is high when all of the gates 12a-12e are high and the clock is high.
- In the clocked OR gate, when a clock pulse is applied, clocking FET 21 is turned on and gating FET 13 is turned off. If any one or more of the logic control gates 12a-12f are up then the output of inverter 14 rapidly rises to supply potential Vdd. When the clock pulse drops to ground potential, clocking FET 21 is turned off and gating FET 13 is turned on. When this occurs, the potential of the common output 16 rises rapidly to supply potential Vdd and the output 17 of the inverter 14 rapidly drops to ground potential.

Latching Clocked CLIP Logic Gates

- Latching Clocked CLIP AND gate - Latching FET 23 ensures that the output 17 of complementary inverter 14 remains unchanged during the clock period, regardless of any change in voltage at the inputs 12a-12e.
- Latching Clocked CLIP OR gate -
 - ◆ The output 17 of complementary inverter 14 is fed back to the gate 24a of the latching FET 23a.
 - ◆ During the clock pulse interval, if any one of the driving stage transistors 11a-11e is turned on by virtue of its control 12a-12f being at supply potential, the output 17 of the complementary inverter 14 is switched up to supply voltage Vdd. When this condition occurs, FETs 21 and 23 conduct, thereby latching the complementary inverter output 17 up at the supply potential until the end of the clock pulse. When the clock pulse potential drops to ground potential, gating FET 13 turns on and clocking FET 21 turns off, forcing the output of the complementary inverter 14 to rapidly drop to ground potential while simultaneously turning off latching transistor 23

Search report of patent office

- No documents are cited as X or Y attack

Search result

Search strategies

Patent search

- Database used - Micropat

| S.No | Scope | Concept | Query | Hits |
|------|------------------|--|--|------|
| 1 | Claims, Title or | P or N channel FET's used to increase the speed, | Query - ((p or n) adj2 (channel or type) NEAR (FET or (field adj1 effect adj1 transistor*))) AND (((increase or step adj1 up or increment or high) NEAR (speed or | 134 |

| | | | | |
|----|---------------------------|--|--|-----|
| | Abstract | minimize the capacitance, minimize delay time | performance)) OR ((minimize* or reduc* or lower* or (cut adj1 down)) NEAR capacitance) OR ((minimize* or reduc* or lower* or (cut adj1 down)) NEAR delay)) Priority Date (earliest): <19910131 | |
| 2 | Claims, Title or Abstract | Increase the speed of the logic circuits that includes transistors | Query - (increase or step adj1 up or increment or high OR enhanc*) SAME ((logic adj1 (circuit or gate or stage)) AND ((p or n) adj2 (channel or type) NEAR (transistor or *FET*1 or (field adj1 effect adj1 transistor*)))) Priority Date (earliest): <19910131 | 32 |
| 3 | Claims, Title or Abstract | FET?s connected in parallel with the drains connected to Vdd | Query - ((p or n) adj2 (channel or type) NEAR (FET*1 or (field adj1 effect adj1 transistor*))) WITH parallel WITH (Vdd or potential or supply) Priority Date (earliest): <19910131 | 58 |
| 4 | Full patent spec. | FET?s connected in parallel to increase the speed | Query: ((p or n) adj2 (channel or type) NEAR (FET*1 or (field adj1 effect adj1 transistor*))) WITH parallel WITH (Vdd or potential or supply) AND (logic adj1 (circuit or gate)) AND (((increase or step adj1 up or increment or high) NEAR (speed or performance)) OR ((minimize* or reduc* or lower* or (cut adj1 down)) NEAR capacitance) OR ((minimize* or reduc* or lower* or (cut adj1 down)) NEAR delay)) Priority Date (earliest): <19910131 | 33 |
| 5 | Full patent spec. | FET Connection having common output | Query - ((p or n) adj2 (channel or type) NEAR (*FET*1 or (field adj1 effect adj1 transistor*))) SAME (parallel and (Vdd or potential or supply) and (common adj1 output)) Priority Date (earliest): <19910131 | 22 |
| 6 | Full patent spec. | FET?s with channel width, channel lengths and saturation current described | Query: (channel adj1 (width and length)) and (saturation adj1 current) and ((p or n) adj2 (channel or type) NEAR (FET*1 or (field adj1 effect adj1 transistor*))) Priority Date (earliest): <19910131 | 13 |
| 7 | Full patent spec. | FET?s of gating stage connected serially to common output and ground | Query: ((p or n) adj2 (channel or type) NEAR (FET*1 or (field adj1 effect adj1 transistor*))) WITH (((serial or serially) NEAR2 (connected or connection)) and (ground or VSS or potential)) Priority Date (earliest): <19910131 | 98 |
| 8 | Claims | Increasing the speed in the logic circuits | Query - (increase or step adj1 up or increment or high) WITH (logic adj1 (circuit or gate)) AND (transistor or FET*1 or (field effect transistor*)) and speed Priority Date (earliest): <19910131 | 100 |
| 9 | Full patent spec. | Common diffusion to minimize the internal capacitance | Query: ((common or shared or mutual) WITH diffusion) and ((minimize* or reduc* or lower* or (cut adj1 down)) NEAR capacitance) AND (FET or (field adj1 effect adj1 transistor*) or transistor) Priority Date (earliest): <19910131 | 48 |
| 10 | Full patent spec. | Increasing the carrier mobility in P-channel FET?s by doping germanium | Query - (p adj2 (channel or type) NEAR (transistor or *FET*1 or (field adj1 effect adj1 transistor*))) AND ((increase or step adj1 up or increment or high or enhanc* or equalize) NEAR (carrier NEAR mobil*)) AND germanium Priority Date (earliest): <19910131 | 12 |
| 11 | Total | | 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 | 542 |

Note: Other databases will also be used to run these queries with the respective operators of the databases. Databases includes SIP, Google patents etc

Non patent search

Technical Articles

- Database used - Google scholar that covers IEEE
 - ◆ Years - 1985-1990

| S.no | Query | Hits |
|------|--|------|
| 1 | P N channel FET logic increase OR enhance OR high "speed" | 399 |
| 2 | P channel FET logic speed increase OR enhance OR high "germanium" | 52 |
| 3 | FET logic parallel speed drain increase OR enhance OR high OR Vdd OR potential -patents | 267 |
| 4 | FET logic parallel speed increase OR enhance OR high OR Vdd OR potential "common output" | 30 |
| 5 | P N channel FET logic speed inverter OR complimentary "common output" | 4 |
| 6 | P-channel N-channel FET common diffusion "parallel" | 114 |
| 7 | P-channel N-channel FET germanium increase OR enhance OR high "carrier mobility" | 9 |
| 8 | P-channel N-channel FET germanium increase OR enhance OR high "carrier mobilities" | 3 |
| 9 | P-channel N-channel FET germanium increase OR enhance OR high "saturation current" | 6 |
| 10 | P-channel N-channel FET minimize OR decrease OR reduce "internal capacitance" | 4 |
| 11 | Total | 888 |

Magazine articles

- Found one relevant articles from BYTE magazine.
 - ◆ Gallium Arsenide Chips - Volume 9, issue 12 (November, 1984)

Non-Patents Analysis

Analysis 1

| NAME | CLIP FET | | |
|----------------------------|---|---|---|
| <p>FIGURE</p> | | | <p>Gating Stage - P channel connected to VSS and Common Output</p> <p>Inverter Stage - P and N channel FETs connected</p> <p>Driver Stage - N channel FET connected in parallel</p> |
| TYPE | Patent:- US5247212 | IEEE JOURNAL OF | |
| Title | Complementary logic input parallel (CLIP) logic circuit family | A 15-ns CMOS 64 | |
| Assignee | THUNDERBIRD TECH INC (US) | STANLEY E. SCH... L. FRANCH, PAUL... PETER W. COOK... WILLIAM F. POKO... | |
| IPC | H01L21/8238; H01L27/092; H03K3/356; H03K19/0948; H03K19/096; H01L21/70; H01L27/085; H03K3/00; H03K19/0948; H03K19/096; (IPC1-7): H03K17/04; H03K19/003; H03K19/017; H03K19/094; H03K19/20 | | |
| Priority date | 19910131 | | |
| Filing date | 19910131 | | |
| Publication date | 9/21/1993 | 11/5/1986 | |
| Driving stage | P channel FET (CLIP AND gate) / N channel FET (CLIP OR gate) | N channel FET | |
| Connection 1 | FET being connected between a common output and a first potential level (Vdd) | FET being connect | |
| Connection 2 | Control electrode of driving stage FET for receiving logic input signals (Multiple) | Control electrode of | |
| Gating stage | N channel FET (CLIP AND gate) / P channel FET (CLIP OR gate) | P channel FET | |
| Connection 1 | FET being connected between a second potential level (Ground or Vss) and common output. | FET being connect | |
| Connection 2 | Control electrode of gating stage FET is connected to a control electrode of driving stage FET, | Control electrode of shown in figure. It | |
| Complementary FET inverter | Complimentary P & N channel FETs | Complimentary P | |
| Connection 1 | FET?s are serially connected between said first and second potential levels (Vdd and (Vss or grnd)) | FET?s are serially | |
| Connection 2 | Inverter input being connected to common output. | Inverter input bein | |

$$Z_n = \frac{I_{satp}^*}{I_{satn}^*} Z_p \left(\frac{L_n}{L_p} \right) \frac{S_n}{2}$$

Zg - channel width of gating transistors, Zd - channel width of driving transistors, I@*satd - saturation current for square channel driving transistor, I@*satg - saturation current for square channel gating transistor, Lg - channel length of gating transistors, Ld - channel length of driving stage transistors, and Sg - number of gating transistors

Since the connect

Analysis 2

- Claim 21 - Germanium doped P-channel FET
- The document describes germanium doped P-channel FET for increasing the channel mobility (Page 2630)

Marked document

- 15-ns CMOS 64K RAM
- Germanium p-Channel MOSFET's with High Channel Mobility

Conclusion

- The article describes a similar driving stage, gating stage and inverter stage as shown in the above table. Only one extra stage for low order bits is added which is optional can be seen in the figure listed to the right side of above table shown as unmarked stage.
- Hence the article invalidates the inforce patent