

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 42

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

MAILED

JUN 21 1996

Ex parte HIROSHI MOMOSE,
TAKEO MAEDA,
and KOJI MAKITA

PAT.&T.M. OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

Appeal No. 94-2034
Application 07/860,596¹

HEARD: June 4, 1996

Before HARKCOM, Vice Chief Administrative Patent Judge, and
HAIRSTON and BARRETT, Administrative Patent Judges.

BARRETT, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claim 19, the sole remaining claim.

¹ Application for patent filed March 30, 1992, entitled "Inverter Gate Circuit of a Bi-CMOS Structure Having Common Layers Between FETs and Bipolar Transistors," which is a continuation of Application 07/472,273, filed January 30, 1990, now abandoned.

The invention is directed to an inverter semiconductor device in which the drain of a MOSFET is connected to the base of a bipolar transistor, wherein the drain and base are formed in a region of uniform impurity concentration. The source of the MOSFET has a higher impurity concentration, recited to be substantially 10^{20} cm^{-3} , than that of the drain, recited to be substantially within a range of 10^{18} to 10^{19} cm^{-3} .

Claim 19 is reproduced below.

19. An inverter semiconductor device comprising:

a positive power source for providing power to said semiconductor device;

a ground;

an input terminal for inputting an input signal;

an output terminal for outputting an inverted input signal;

a p-channel MOSFET having a first source connected to said positive power source, a first gate connected to said input terminal, and a first drain;

an npn bipolar transistor having a first collector connected to said first source, a first base connected to said first drain, and a first emitter connected to said output terminal, said first drain and said first base being formed within one first region defined within the semiconductor device, said first source having a higher impurity concentration than that of said first drain, and the impurity concentration of the first drain and first base being determined in accordance with the characteristics of the npn bipolar transistors;

an n-channel MOSFET having a second drain, a second gate connected to said input terminal, and a second source; and

a pnp bipolar transistor having a second emitter connected to both said output terminal and said first emitter, a second base connected to said second drain, and a second collector connected to said ground, said second drain and said second base being formed within one second region defined within the semiconductor device, said second source having a higher impurity concentration than that of said second drain, and the impurity concentration of the second drain and second base being determined in accordance with the characteristics of the pnp bipolar transistors,

wherein the impurity concentration of the first and second drains is substantially within a range of 10^{18} to 10^{19} cm^{-3} , and the impurity concentration of the first and second sources is substantially 10^{20} cm^{-3} .

The examiner relies on the following references:

Nishitani et al. (Nishitani)	4,597,827	July 1, 1986
Kasai et al. (Kasai) (Japanese Kokai)	52-26181	February 26, 1977
Umezawa et al. (Umezawa) (Japanese Kokai)	56-152260	November 25, 1981
Atsumi et al. (Atsumi) (Japanese Kokai)	62-200757	September 1, 1987

Claim 19 stands rejected under 35 U.S.C. § 103 as being unpatentable over Kasai, Umezawa, Nishitani, and Atsumi. We refer to the Examiner's Answer entered November 23, 1993 (Paper No. 28) for a detailed statement of the examiner's rejection.

OPINION

We reverse.

Kasai, figures 7 and 8, teaches a p-channel MOSFET MT1 coupled to an npn bipolar transistor BT, having the drain of MT1 and the base of BT formed within a first region, and an n-channel MOSFET MT2 coupled to an pnp bipolar transistor BT2, having the

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drain of MT2 and base of BT2 formed within a second region. The incorporation of the bipolar transistors with the MOSFETs minimizes the surface area required (translation, page 7). Umezawa also discloses incorporating a p-channel device with an npn bipolar transistor to save space.² Umezawa is cumulative to Kasai, inasmuch as the basic structure is shown in Kasai and it is not necessary to further explain why Kasai is as it is. What Kasai and Umezawa do not show are the claimed impurity concentrations of the source and drain.

The examiner applies Nishitani and Atsumi as follows
(Examiner's Answer, page 4):³

Lightly-doped drain (LDD) regions are common; See for example Nishitani or Atsumi, who both teach the drains to be lightly-doped. Nishitani generally teaches the electrical advantages of such structures. The Examiner maintains it would have been obvious to a skilled artisan in this art to combine lightly-doped drain regions as taught in Nishitani and Atsumi with the analogous art structures of Kasai and Umezawa in order to obtain the short channel effects that is well-known in this art.

The examiner's position is not that it would have been obvious for one of ordinary skill in the art to select impurity concentrations for the sources and for the combined drains and

² Note the procedural modifications, especially numbers 13 and 21, on pages 12 and 13 of the translation wherein the labelling of the source and drain are corrected.

³ We agree with appellants' observation (Reply Brief, page 7) that the examiner intended to say "to avoid short channel effects," because Nishitani discusses the problems of short channels.

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bases of the structure in Kasai as recited in claim 19. Instead, as we interpret the examiner's rejection, the examiner concludes that it would have been obvious from Nishitani and Atsumi to add small lightly-doped regions to the drain regions in Kasai and Umezawa to form a lightly-doped drain (LDD) and that this composite drain structure formed of a lightly-doped region and heavily-doped region would meet the terms of claim 19. Although we agree that the proposed modification would have been obvious, the resulting structure does not meet the language of claim 19.

Claim 19 requires "said first drain and said first base being formed within one first region." Kasai shows the drain and base formed within a single region, but the examiner does not rely on this single region; instead, the examiner modifies Kasai to add an additional lightly-doped region. The examiner considers the lightly-doped region and heavily-doped region together to be one region (Examiner's Answer, page 5):

[A]s far as the examiner is concerned, lightly doped drain regions are the additional small portions of lightly doped impurities such as region 222 of Nishitani. The Examiner does not differentiate between just region 222 and a composite of regions 222 and 228 because the prior art in this field fails to differentiate as well.

As noted by appellants (Reply Brief, page 2), Nishitani does differentiate between the lightly-doped drain region and the heavily-doped drain region. However, we understand the examiner's point that an LDD can refer to a composite structure of lightly-doped region and heavily-doped region, and that "one

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first region defined within the semiconductor device" is a broad limitation that does not require a uniform impurity concentration and that can encompass several sub-regions, such as the lightly-doped and heavily-doped regions of a drain region. Thus, initially, the examiner's interpretation of "one first region" as not requiring a uniform impurity concentration is plausible. However, the examiner's proposed modification and claim interpretation are inconsistent with other claim limitations.

Claim 19 requires "said first source having a higher impurity concentration than that of said first drain" and that "the impurity concentration of the first and second drains is substantially within a range of 10^{18} to 10^{19} cm^{-3} ." These limitations require the whole "first drain," and implicitly the whole "first region," to have a single impurity concentration. The examiner's interpretation that the "one first region" can include regions of different impurities is inconsistent with these claim limitations and, accordingly, the proposed modification of Kasai does not make obvious the subject matter of claim 19. Furthermore, under the examiner's proposed modification, only the additional small lightly-doped region of the "first drain" meets the claim limitations. This requires picking and choosing which regions to compare to meet the claim limitations, which involves impermissible hindsight. Although appellants' specification discloses forming an LDD

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