



- (51) International Patent Classification:
H01L 27/11 (2006.01)
- (21) International Application Number:
PCT/US2019/049506
- (22) International Filing Date:
04 September 2019 (04.09.2019)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
62/727,098 05 September 2018 (05.09.2018) US
- (71) Applicant: **TOKYO ELECTRON LIMITED** [JP/JP]; Akasaka Biz Tower, 3-1 Akasaka 5-chome, Minato-ku, Tokyo 107-6325 (JP).
- (72) Inventors: **LIEBMANN, Lars**; Suite 214, NanoFab 300 South 255 Fuller Rd., Albany, New York 12203 (US). **DEVILLIERS, Anton**; Suite 214, NanoFab 300 South 255 Fuller Rd., Albany, New York 12203 (US). **SMITH, Jeffrey**; Suite 214, NanoFab 300 South 255 Fuller Rd., Albany, New York 12203 (US). **TAPILY, Kandabara**; Suite 214, NanoFab 300 South 255 Fuller Rd., Albany, New York 12203 (US).
- (74) Agent: **MATHER, Joshua D.**; Tokyo Electron U.S. Holdings, Inc., 2400 Grove Boulevard, Austin, Texas 78741 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

(54) Title: POWER DISTRIBUTION NETWORK FOR 3D LOGIC AND MEMORY

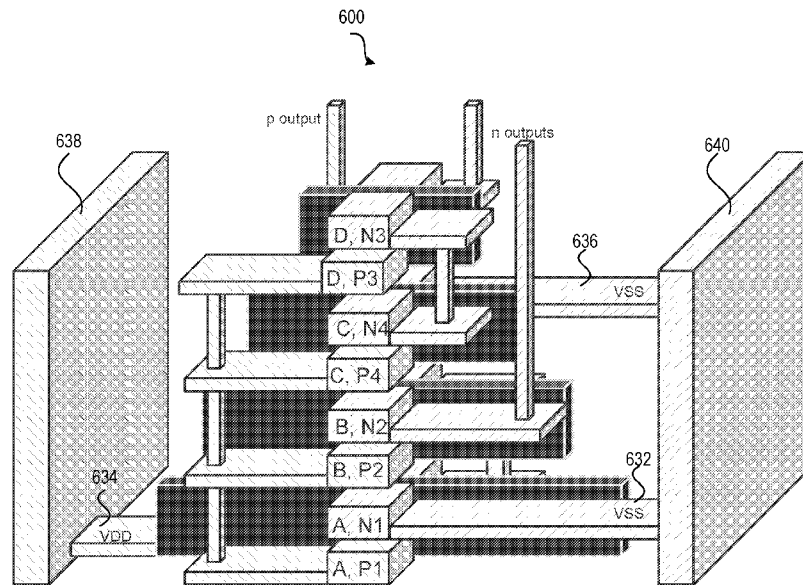


FIG. 4

(57) Abstract: A semiconductor device is provided. The semiconductor device includes a transistor stack having a plurality of transistor pairs that are stacked over a substrate. Each transistor pair of the plurality of transistor pairs includes a n-type transistor and a p-type transistor that are stacked over one another. The plurality of transistor pairs have a plurality of gate electrodes that are stacked over the substrate and electrically coupled to gate structures of the plurality of transistor pairs, and a plurality of source/drain (S/D) local interconnects that are stacked over the substrate and electrically coupled to source regions and drain regions of the plurality of transistor pairs. The semiconductor device further includes one or more conductive planes formed over the substrate. The one or more conductive planes are positioned adjacent to the transistor stack, span a height of the transistor stack and are electrically coupled to the transistor stack.



AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(88) Date of publication of the international search report:

25 June 2020 (25.06.2020)

A. CLASSIFICATION OF SUBJECT MATTER**H01L 27/11(2006.01)**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
H01L 27/11; G06F 17/50; H01L 21/02; H01L 23/528; H01L 23/535; H01L 27/092Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: p-type transistor, n-type transistor, three-dimension, memory**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2018-0122807 A1 (INTERNATIONAL BUSINESS MACHINES CORPORATION) 03 May 2018 paragraphs [0025]-[0041] and figures 1-2	1-20
A	US 2015-0370950 A1 (SYNOPSIS, INC.) 24 December 2015 paragraphs [0070]-[0117] and figures 1A-6B	1-20
A	US 2018-0069011 A1 (TAIWAN SEMICONDUCTOR MANUFACTURING COMPANY, LTD.) 08 March 2018 paragraphs [0021]-[0058] and figures 1-2	1-20
A	US 2017-0221826 A1 (QUALCOMM INCORPORATED) 03 August 2017 paragraphs [0039]-[0040] and figure 2	1-20
A	US 2015-0102419 A1 (KABUSHIKI KAISHA TOSHIBA) 16 April 2015 paragraphs [0017]-[0023] and figures 1-5	1-20

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

19 May 2020 (19.05.2020)

Date of mailing of the international search report

20 May 2020 (20.05.2020)

Name and mailing address of the ISA/KR

International Application Division
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

JUNG, Jong Han

Telephone No. +82-42-481-5642



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2019/049506

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2018-0122807 A1	03/05/2018	US 2018-0108659 A1 US 9947664 B1	19/04/2018 17/04/2018
US 2015-0370950 A1	24/12/2015	CN 106663594 A EP 3158577 A1 US 10256223 B2 US 2015-0370948 A1 US 2015-0370951 A1 US 2016-0329313 A1 US 9378320 B2 US 9400862 B2 WO 2015-200363 A1	10/05/2017 26/04/2017 09/04/2019 24/12/2015 24/12/2015 10/11/2016 28/06/2016 26/07/2016 30/12/2015
US 2018-0069011 A1	08/03/2018	CN 106158867 A CN 106158867 B KR 10-1836578 B1 KR 10-2016-0134445 A TW 201640651 A TW I572012 B US 10157928 B2 US 2016-0336329 A1 US 9419003 B1 US 9825043 B2	23/11/2016 01/03/2019 08/03/2018 23/11/2016 16/11/2016 21/02/2017 18/12/2018 17/11/2016 16/08/2016 21/11/2017
US 2017-0221826 A1	03/08/2017	CN 105474393 A CN 105474393 B CN 109148400 A EP 3036768 A1 EP 3036768 B1 JP 2016-535454 A JP 2018-014507 A JP 6199494 B2 JP 6449394 B2 US 10074609 B2 US 10580774 B2 US 2015-0054567 A1 US 2018-0342515 A1 US 9786663 B2 WO 2015-027025 A1	06/04/2016 30/11/2018 04/01/2019 29/06/2016 08/03/2017 10/11/2016 25/01/2018 20/09/2017 09/01/2019 11/09/2018 03/03/2020 26/02/2015 29/11/2018 10/10/2017 26/02/2015
US 2015-0102419 A1	16/04/2015	JP 2014-003184 A JP 5826716 B2 TW 201401487 A TW I525795 B US 9721951 B2 WO 2013-190863 A1	09/01/2014 02/12/2015 01/01/2014 11/03/2016 01/08/2017 27/12/2013