

(19) (KR)
(12) (A)

(51) 。 Int. Cl. 7 (11) 2003-0033959
G11C 11/34 (43) 2003 05 01

(21) 10-2002-0064452
(22) 2002 10 22

(30) JP-P-2001-00324357 2001 10 23 (JP)

(71) 가 가 가 4 6

(72) 1 5-1 가 가

1 5-1 가 가

1 5-1 가 가

1 5-1 가 가

(74)

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(54)

SRAM 가 LSI , , .
LSI , ,
SRAM , .

1

MIS , , ,

1		LSI	SRAM	.
2	1	LSI	.	
3	1		가	.
4	1	CNTS	.	
5	1		.	
6	5		.	
7		SRAM	.	
8			.	
9		LSI	.	
10		1	.	
11	10		가	.
12		2	.	
13		3	.	
14	13	.		
15	SRAM	.		
16	15		가	.
17	16	CNTV1	.	
18	7	SRAM	1	.
19	7	SRAM	2	.
20			.	
21	SRAM	1	.	
22	21	SRAM	.	
23	21		.	
24	SRAM	2	.	
25	SRAM	3	.	
26	24	CNVT2	.	

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CHIP :

LOGIC, LOGIC1, LOGIC2 :

SRAM, SRAM1, SRAM2 :

POW :

VssQ :

VddQ :

Vss : ()

Vdd :

stby :

Vbn : nMOS

Vbp : pMOS

N1 N10 : nMOS

P1 P12 : pMOS

cntn, cntp, cntn1, cntn2, cntmn1, cntmn2, cntmn3, cntp1, cntp2, cntp3, cntp4, cntmp1, cntmp2, cntmp3 :

CNTS, CNTS2 CNTS5 :

VBBC, VBBC2 :

Vddl, Vssl, Vssl1, Vssl2 :

IO :

ack :

FF :

BUS :

BSCNT :

PDC :

MAR :

PERI1, PERI2 : SRAM

CORE : SRAM

WL :

BL, /BL

WDR :

RWAMP : .

PRE :

CDEC :

RDEC :

MCNT :

Vddma, Vssma, Vddamp, Vssamp, Vddperi, Vssperi :

OBUF :

cntvbb1, cntvbb2 :

SW1 :

Vbpl, Vbnl :

Vbpm, Vbnm : SRAM

MEM1, MEM2 : SRAM

BLK1 BLK2 : SRAM

CNTV1, CNTV2 :

tox :

(SRAM) 가 .

7-86916

MOS

2000-207884

LSI

2001-93275

, SRAM

LSI(Large Scale Integrated Circuit:

)

가

, SRAM ,

SRAM

(DRAM)

가 . , , SRAM

가 . , 가

LSI , 0.13 μ m 가 LSI가 .

MOS , 1.2V LSI가 , LSI MOS

MOS 가 가 .

S , , MOS 가 , LSI , SRAM 가 MO 가

가 , SRAM LSI , SRAM SRAM 가 MOS , MOS MOS

OS 가 , SRAM , SRAM , SRAM 가 M

(1) M SRAM 가 LSI MOS , SRA .

(2) SRAM

(3) SRAM SRAM , SRAM

< >

 $\langle 1 \rangle$

1 , LSI CHIP , SRAM VssQ VddQ IO(IO) ,
 , LOGIC , VssI nMOS SRAM , N1 ,
 Vss stby가 N1 cntn
 CNTS , stby가 SRAM Vbn Vbp N1 VBBC
 , Vss 가 (가)
 (Vss-Vdd) (VssQ-VddQ) Vdd Vdd 3.3V, Vdd 1.2V, Vss VssQ 0V
 CNTS stby IO IO
 1 SRAM)가 2 IO(IO) (IO

MOS 가 MOS 가 IO POW
 , VBBC, CNTS , 1
 . (,)가 SRAM . ,
 1 N1 IO 가 nMOS MOS N1
 가 N P MOS , 가 , nMOS
 MOS N1 가 , LSI 가 1 IO
 MOS 가 MOS , 가
 , MOS N1, MOS N1 , 가
 , 가 .
 nMOS , nMOS pMOS
 가 가 , , Vss nMOS ,
 Vdd pMOS 가 .
 ACT STB 3 ACT
 SRAM 가 Vdd 1 Vdd Vss SRAM ,
 pMOS , 1.2V, Vss 0.0V . stby가
 가 nMOS Vbn Vbp , SRAM nMOS
 Vbs 0V , SRAM MOS MOS
 (, ,)
 nMOS 가 stby가 , SRAM nM OS cntn
 가 Vbn Vbp가 -1.2V 2.4V , SRAM MOS pMOS
 가 , MOS MOS 1.2V .
 stby cntn , 4
 .
 4 가 3 STB stby 가
 STB stby , ACT , STB ack가 stby가
 cntn ack cntn 가 5 . stby가
 k가 cntn 가 ac
 5 CNTS 6 ACT STB
 . ,
 7 1 SRAM SRAM PERI1 PERI2, PERI1 . SRAM MAR ,
 가 MOS s_sw2 s_sw1 s_sw2m PERI2 Vss Vdd stby
 p , N MOS Vbn P MOS Vb
 MAR SRAM (1 2 P MOS (BL, /BL) 1 2 N MOS
) , 2 MOS 1 WL 2 N .
 MOS . N MOS

Vddma Vssma .
 WL PERI1 WDR . PERI1 RDEC, MCNT Vddper Vssper
 PERI2 CDEC PRE, BL RWAMP
 RWAMP OBUF, WCNT . PERI2 가
 Vddamp Vssamp /stby , STB PERI2 Vbn
 Vss가 MOS MAR, PERI1 PERI2 Vdd가 MOS , SRAM
 Vbp MOS 가 , SRAM
 7 , 2 , Vss Vdd 가 .
 , Vdd , Vss , Vdd , SRAM , Vss , Vdd
 , Vss , Vdd , Vss , Vdd 가
 가 Vss , Vss Vdd ,
 7 가 , 1 , 7 LSI SRAM , LSI LSI
 가 , MOS 가 , MOS 가 , SRAM
 MOS 가 , LSI SRAM
 8 1 LOGIC LOGIC_CIR P MOS
 N MOS , NAND, NOR 가 , P MOS Vssl
 Vdd , N MOS
 9 LSI SRAM (CORE) MOS , LSI IO
 MOS , 1 S_SW logic sw MOS ,
 7 . P MOS N MOS , LSI
 가 , 16 가 , MOS 가 , MOS
 가 MOS 가 6.7nm , MOS 가 , MOS
 2 가 MOS 가 , MOS 가 .
 9 , Vth가 0.40V 0.25V 2 MOS 가
 MOS , LOGIC_CIR SRAM SRAM_CIR Vth가 MOS ,
 MOS , IO , LOGIC_CIR SRAM_CIR 2 Vth , LOGI
 C_CIR , (SNB) MAR PERI SRAM_CIR

MOS
 Pattern1 , Vth가 MOS , SRAM
 MOS , Vth가 MOS , SRAM
 가 ,
 , SRAM , SRAM , SRAM
 , Pattern1 , SRAM , SRAM
 MOS , SRAM , SRAM
 Pattern1 , SRAM , SRAM , SRAM
 ,
 Pattern2 SRAM , LSI SRAM , SRAM , SRAM
 Vth가 MOS , Pattern1 , SRAM , Pattern2 SRAM
 MOS 가 , SRAM 가 ,
 Pattern3 MOS SRAM MOS , Pattern2 Vth가
 MOS 가 , LSI MOS 가 ,
 , SRAM ,
 , LSI ,
 < 2>

10 1 2
 Vss Vdd Vss , 가 IO , 1 10 가
 , 10 , CHIP IO ,
 10 , pMOS P1 STB 11 cntp가 가 11 , 3 Vdd ACT
 , , 4 6 , 7 , cntp CNTS2
 가 ,
 1 10 1 가 1 12 12
 가 2 가 2 LSI , , 3 ,
 가 , 12 Vss1 Vss12, Vss1 Vss12 LSI ,
 LOGIC2 N3, SRAM, CNTS SRAM LOGIC1 LOGIC2, LOGIC1 N2
 , 1 VBBC
 , 가 ,
 Vdd 가 pMOS 가 , Vss nMOS Vdd Vss 2

13 cntn1 cntn2 LSI , cntn1 cntn2 가 가 , 가 CNTS3
 12 . CNTS3 N2 N3 cntn1 cntn2 가 가 , SRA
 가 , 가 . M
 13 , 12 가 , 3 Vss Vd
 가 가 . 13
 , 가 SRAM 가 ,
 가 .
 14 13 CPU 가 () LSI
 DSP CPU SRAM CPU BUS
 BSCNT IO .
 가 , BSCNT stat1
 , CNTS3가 cntn1 cntn2
 N2 N3 SRAM Vbn
 Vbp , CPU DSP SRAM 가 BSCNT가
 stat1 , CPU , CPU , DSP N3 DSP
 가 .
 < 3>
 15 , SRAM LSI . LS
 I CHIP , LOGIC , SRAM , Vss
 N1 Vssl 가 nMOS N1 cntn VBBC , stby CNTS , stby가 SRAM Vddm
 Vbn Vbp CNTV1 .
 15 CNTV1 1 가 , CNTV1 1
 . CNTV1 stby 가 , SRAM Vdd
 가 Vdd , SRAM 가
 가 , 1 .
 15 ACT STB 16 Vdd 1.
 2V dm ACT . stby, cntn, Vbn, Vbp 1 STB 3 . SRAM Vd
 M ACT 1.2V , 0.6V . , SRA
 15 CNTV1 , 16 . CNTV1 PDC
 . SRAM 가 ACT Vdd SRAM Vdd
 Vddm STB , stby 가 , Vddlow SRAM Vdd
 SRAM , SRAM Vdd , 15 가 ,
 CNTV1 Vssm Vss , CNTV1 가 .
 ,
 < 4>

18, 7, 7, Vddma, Vssma, Vddper, Vssper, SRAM, RWAMP, Vddamp, Vssamp, PERI2, PERI1, MOS, P, MOS, 3, 3, cntmp1, cntmp2, cntmp3, cntmn1, cntmn3, P6, P7, N6, N8, P8, N7, SRAM, P6, N, Vssamp, cntmn2, cntmp2, Vdd, 18, 19, 7, 7, CDEC, Vss, CDEC, Vddper, Vssper, WDR, Vdd, MNCT, Vddper, Vssper, WCNT, Vddper, Vssper, 19, 18, 3, (Vdd, Vddma, Vddamp, Vddper, Vss, Vssma, Vssamp, Vssper, N, P, MOS, SRAM, Vddamp, P, MO, S, Vssper, N, MOS, RDEC, SRAM, 가, SR, AM, 7, Vdd, Vss, MOS가, 가, 가, 가, 가, 가, 19, Vdd, Vss, NAND, Vdd, Vss, ss, Vdd, Vss, SRAM, 가, 가, 가, 가, 가, 가, Vdd, Vss, 가, 19, SRAM, 가, < 5>, 20, 1, SRAM, LSI, SRAM

가 SRAM1
MOS
가 SRAM2 MOS
SRAM2
가
SRAM2
가
Pattern3, SRAM1 MOS, SRAM2 MOS
MOS SRAM, SRAM
가
가 MOS
Pattern4, Pattern3 SRAM2 MOS MOS
, Pattern3
23, 21 LSI CHIP, LOGIC, SRAM1 SRA
M2, Vssl SRAM 가 nMOS N9, Vss BUS, Vssml
CNTS5, 가 nMOS Vbn Vbp cntn dtran
VBBC
21, LSI SRAM
21 LSI 가, 23 21 가
CNTS5
LSI AM1, CNTS5 dtran, SR
가 가 CNTS5 SRAM2 dtran
가 가 CNTS5 SRAM1
CNTS5 가 가 SRAM1 SRAM2 SRAM2
가 가 SRAM1 SRAM2 SRAM1
dtran 가 가
24, SRAM CNTV1 2 SRAM 15
(SRAM1, SRAM2
15 가, S
RAM CNTV2 17 가
25 SRAM 3 SRAM 4 SRA
M SRAM1, SRAM2, SRAM3 SRAM4, P MOS
P9, P10, P11 P12, CNTS6 가 P MO
S, SRAM N
21
가 가

SRAM 가 LSI 가

(57)

1. MIS

MIS 1 ,

MIS

MIS N MIS P MIS 가 ,

N MIS P MIS

MIS

3 4. ,
MIS 2
,
1 2 MIS
MIS , MIS
1 MIS 2 MIS
.
4 5. ,
3
,
, 3 가 .
3 6. ,
1 MIS 1 , 2 가 가
,
MIS 1 MIS 가 MIS
2 ,
MIS 1 MIS 가
MIS 2 MIS 1 MIS .
7. N 1 MIS , 2 MIS , 3 MIS , 4 MIS 가 1
,
N 5 MIS , 6 MIS , 7 MIS , 8 MIS 가 2
,
1 MIS 5 MIS
.
8. 7 ,
9 MIS ,
10 MIS 가 ,
9 MIS 1 MIS ,
10 MIS 5 MIS
.

9.

7 ,
 ,
 MIS 1 MIS
 ,
 MIS 5 MIS
 ,
 1 P 9 MIS 10 MIS ,
 2 P 11 MIS 12 MIS 가 ,
 3 MIS 4 MIS 4 MIS , 1 MIS 2 MIS
 4 MIS 3 MIS , 3 MIS 2 MIS ,
 7 MIS 8 MIS 8 MIS , 5 MIS 6 MIS
 8 MIS 7 MIS , 7 MIS 8 MIS
 .

10.

7 ,
 1 . 9 MIS
 ,
 9 MIS 1 , 2 가 ,
 2 1 , 1 2
 .

11.

,
 ,
 . ,
 ,
 1 1 ,
 . 2 2 .

12.

11 ,
 1 1 . 가 P 1 MIS
 ,
 2 . 2 . 가 N
 2 MIS .

13.

12 ,

MIS

가

,

MIS

3 MIS

3 MIS

1 MIS

14.

11

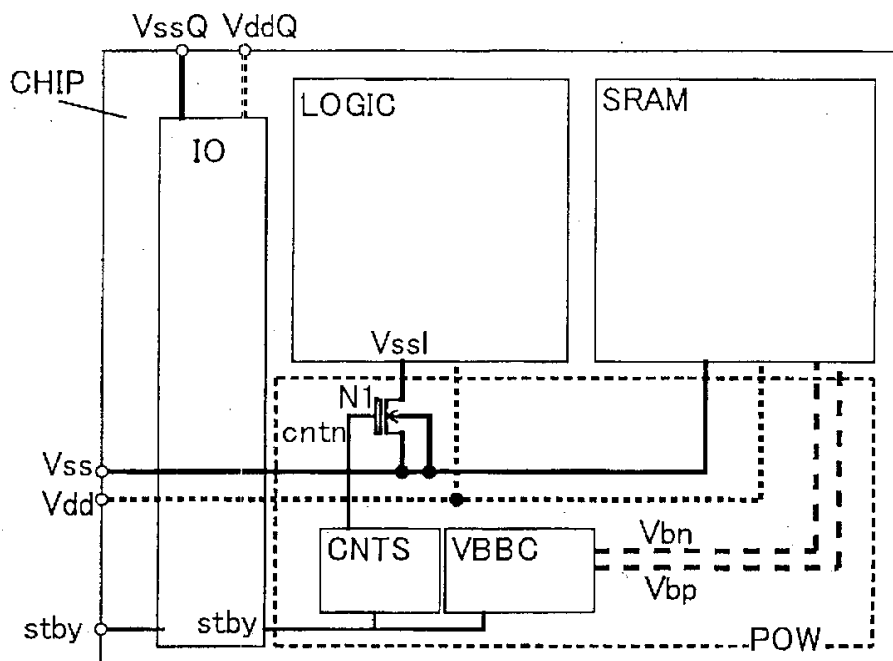
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14

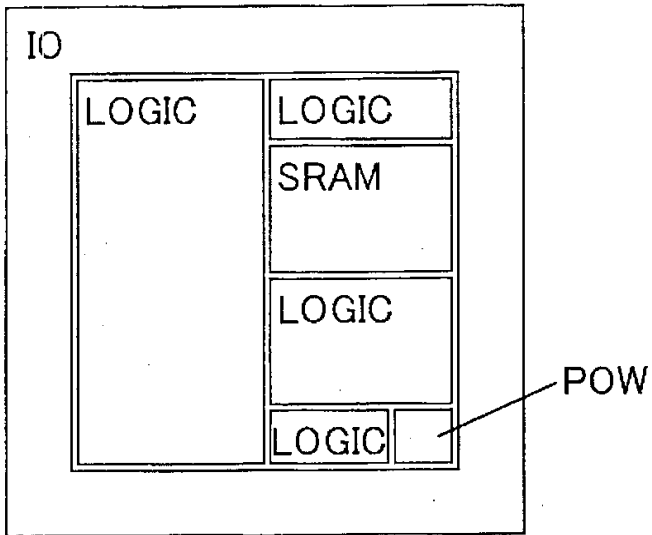
MIS

MIS

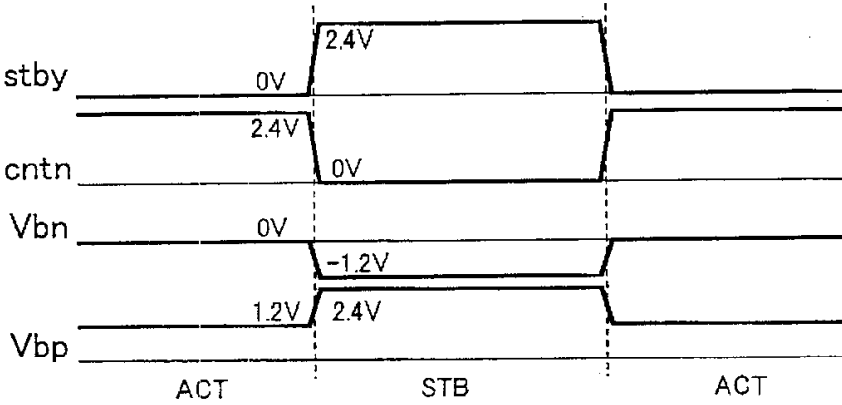
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2

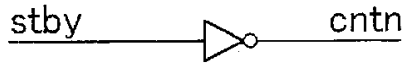


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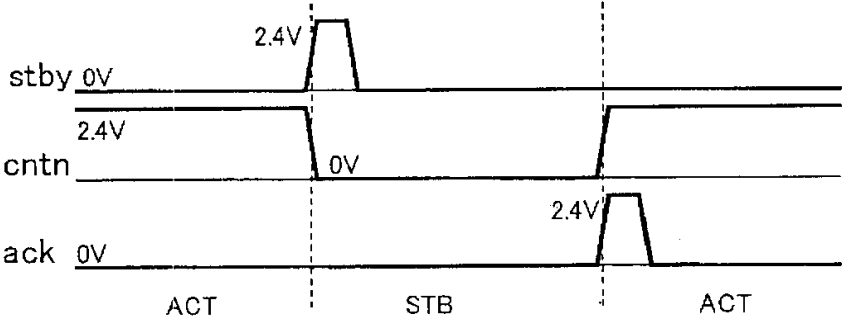


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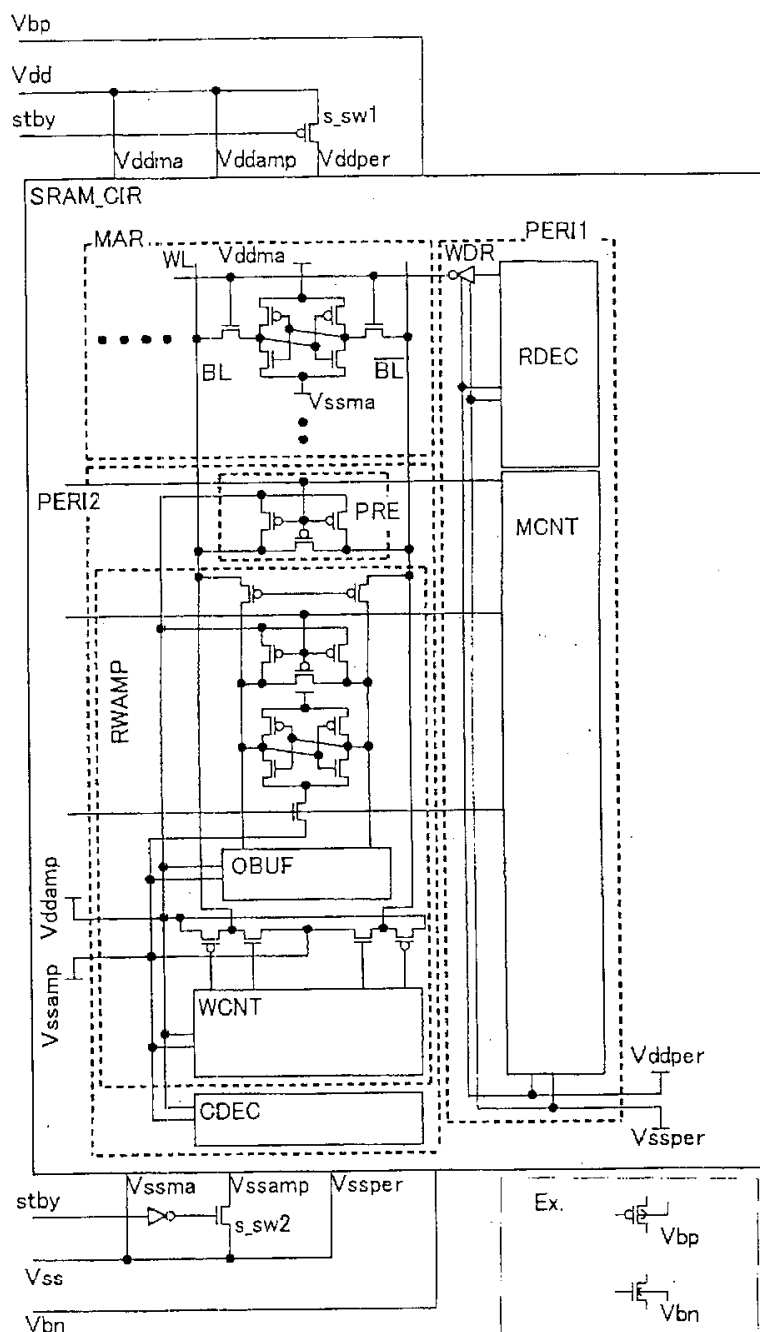
CNTS



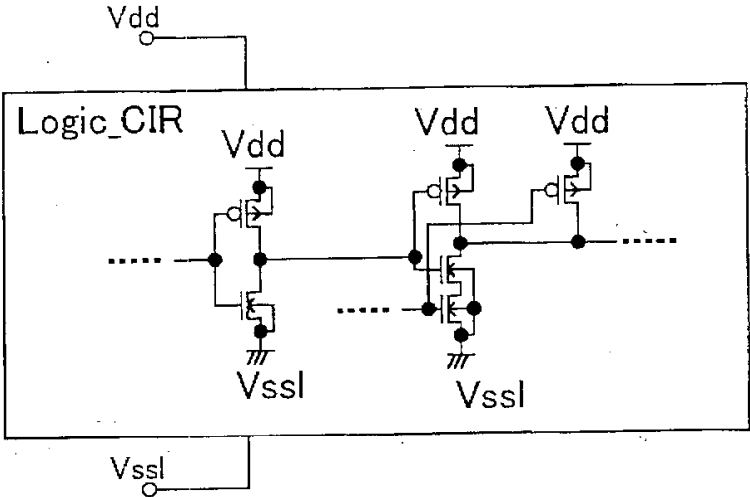
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7



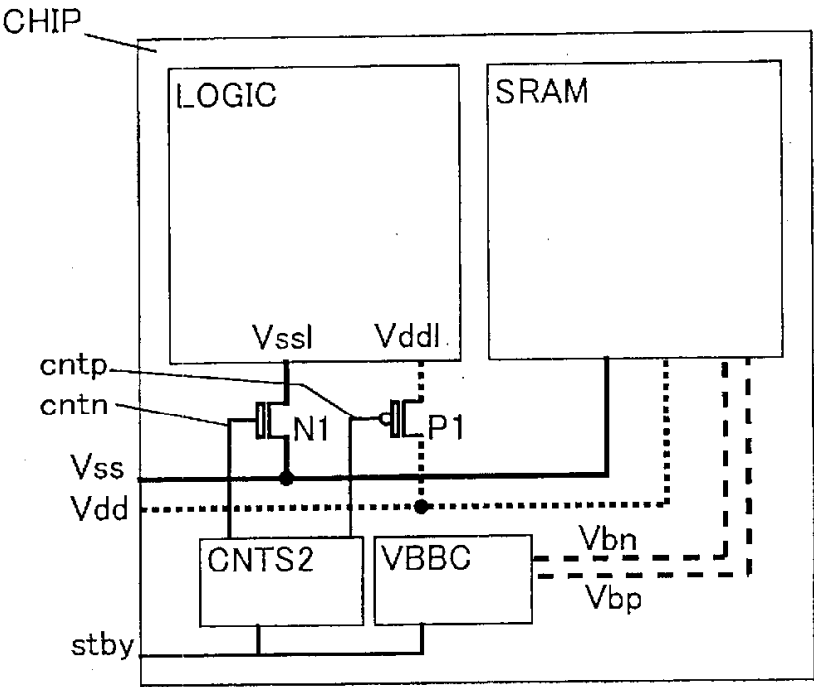
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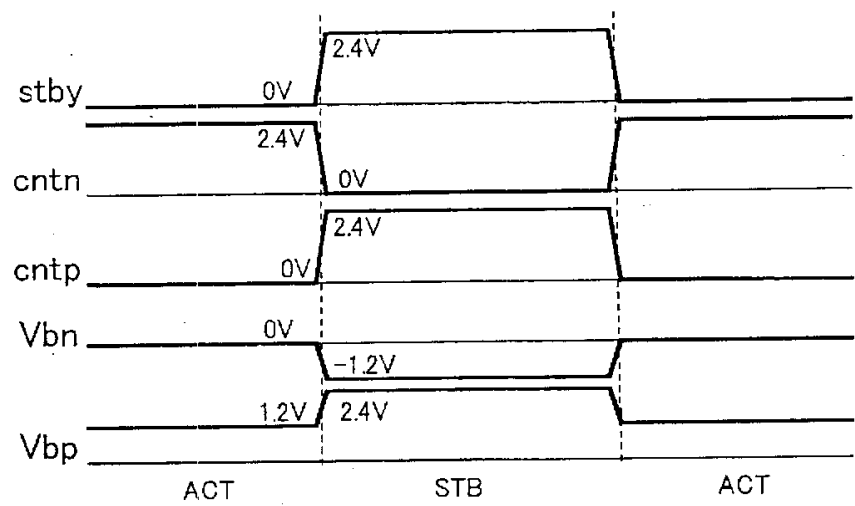
9

		Logic_CiR	Logic sw (N1)	SRAM_CiR	SRAM sw (s_sw1, s_sw2)	IO
Pattern1	Tox	2.0nm	6.7nm	2.0nm	2.0nm	6.7nm
	Vth	0.25V, 0.40V	0.80V	0.25V, 0.40V	0.40V	0.80V
Pattern2	Tox	2.0nm	6.7nm	2.0nm	6.7nm	6.7nm
	Vth	0.25V, 0.40V	0.80V	0.25V, 0.40V	0.40V	0.80V
Pattern3	Tox	2.0nm	6.7nm	2.0nm	2.0nm	6.7nm
	Vth	0.25V, 0.40V	0.80V	0.25V, 0.40V	0.40V	0.80V

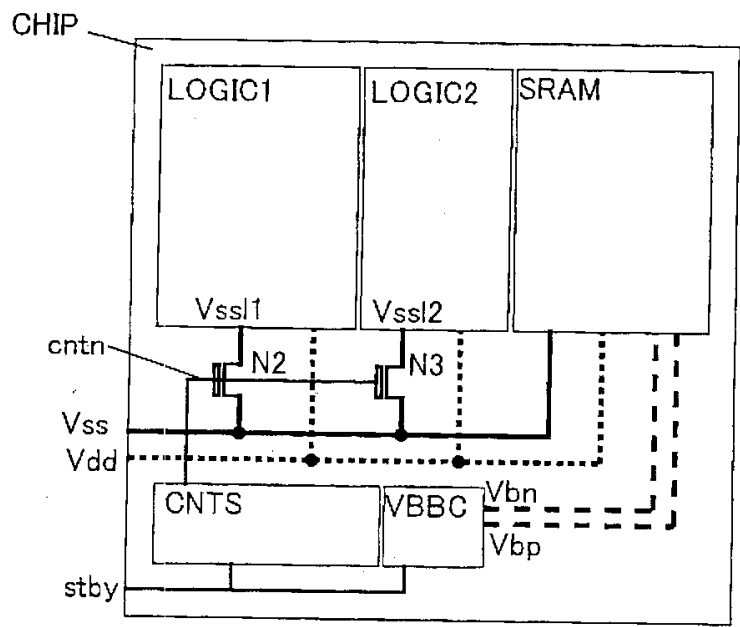
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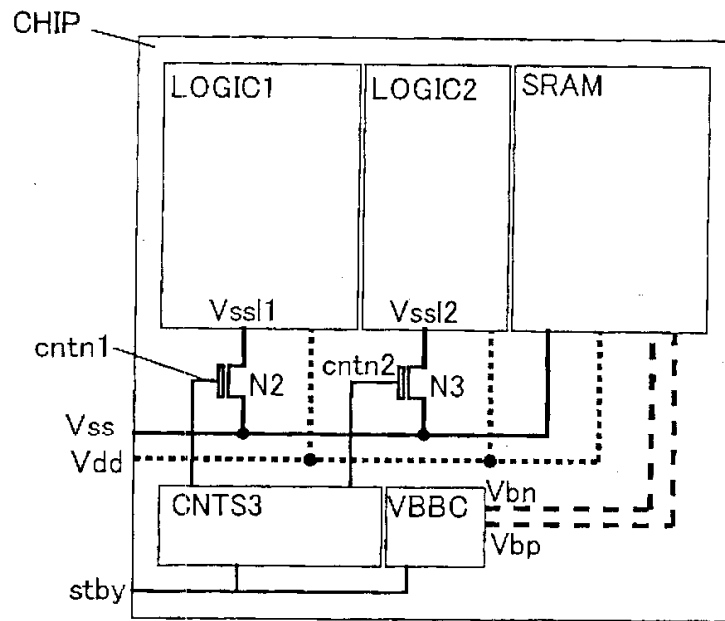
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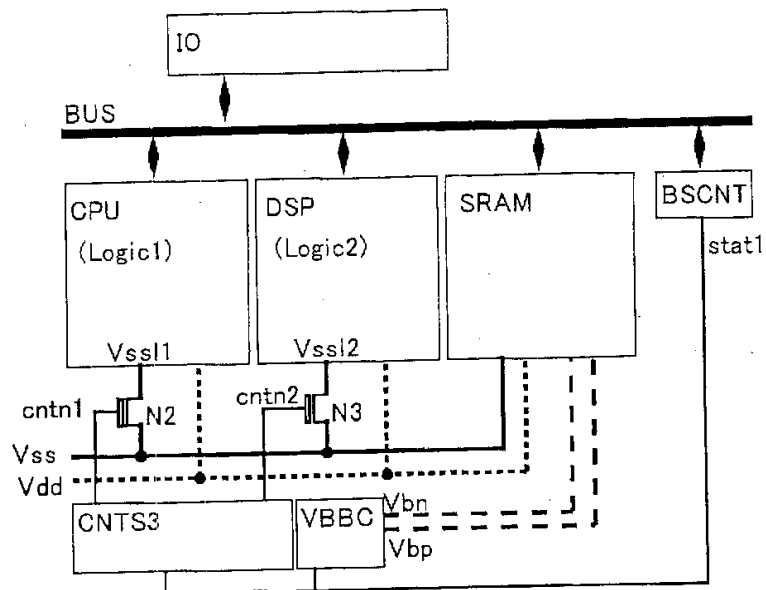
12



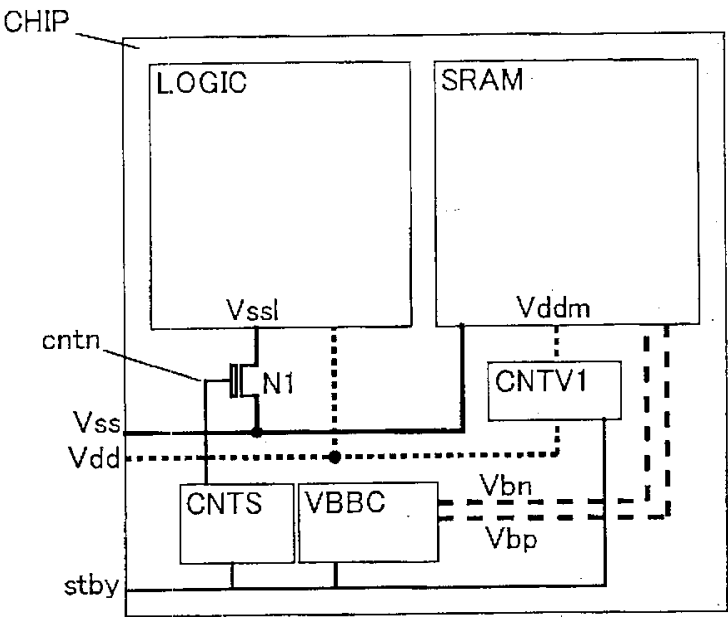
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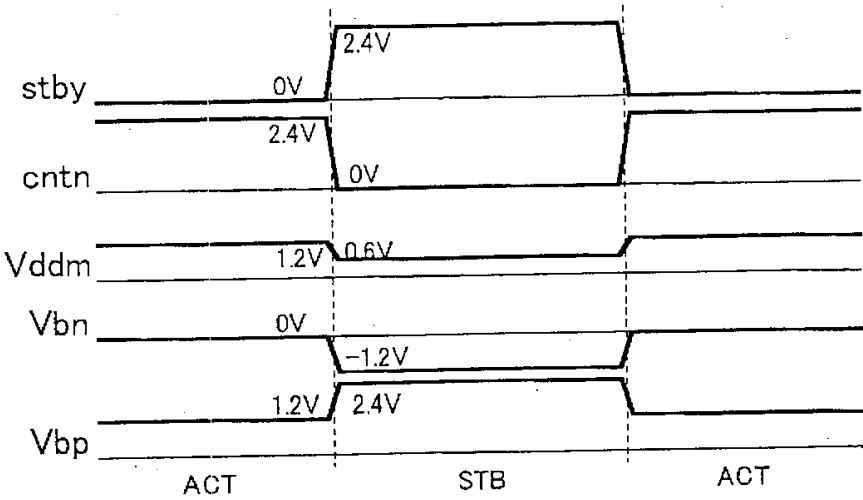
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15

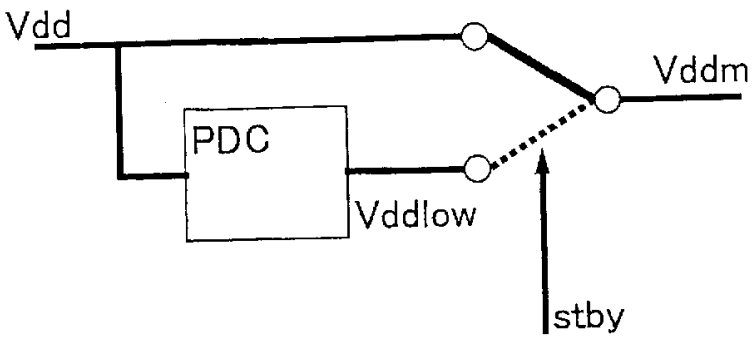


16

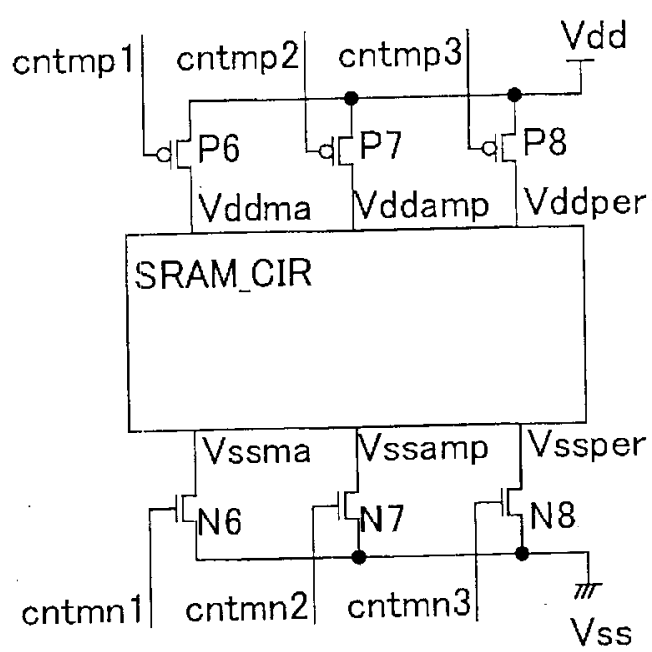


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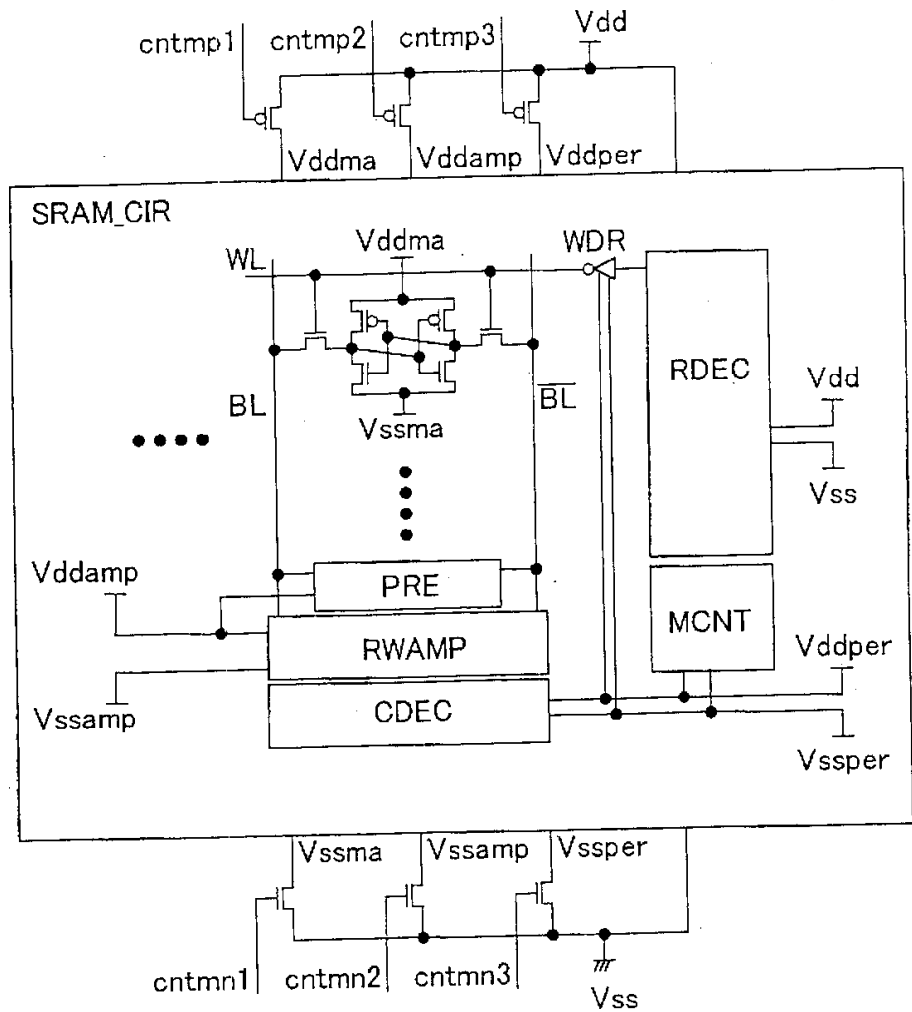
CNTV1



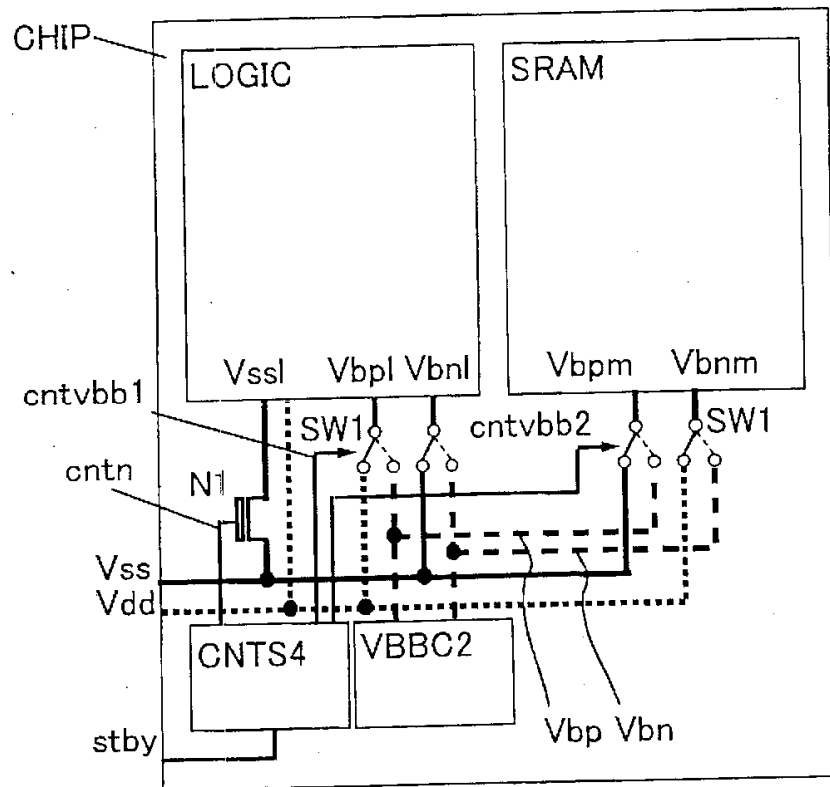
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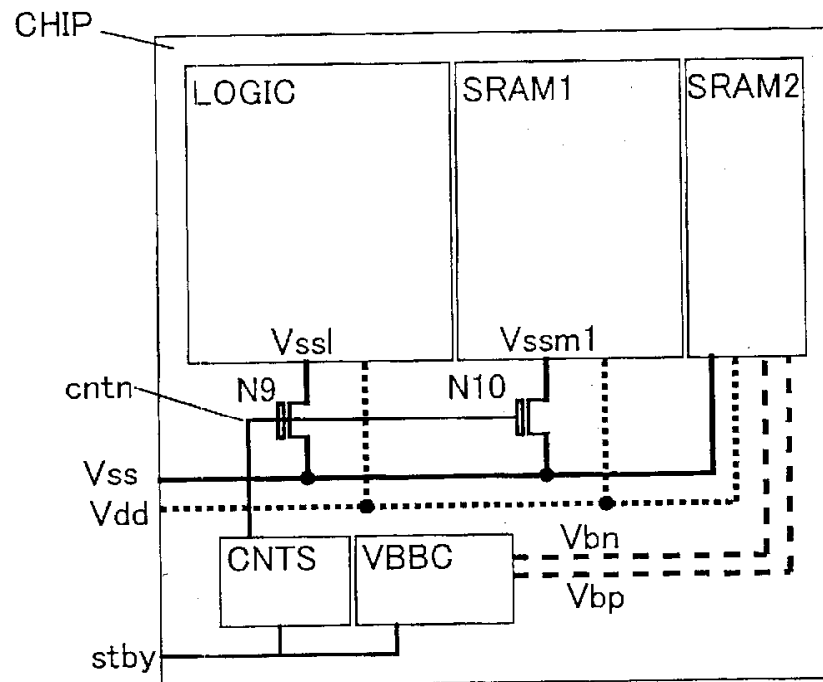
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20



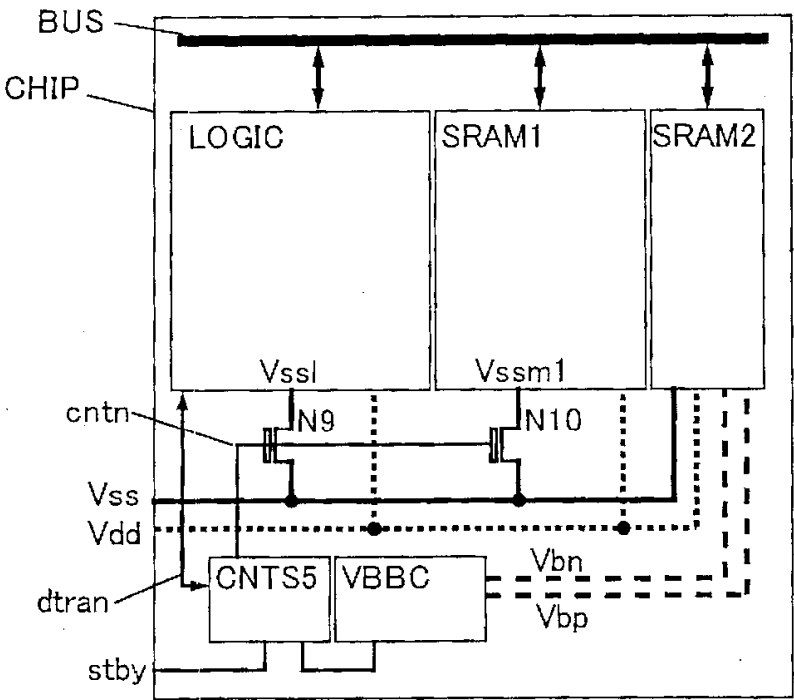
21



22

		Logic_CIR	IO	MAR1	MAR2
Pattern1	Tox	2.0nm	6.7nm	2.0nm	2.0nm
	Vth	0.25V, 0.40V	0.80V	0.40V	0.40V
Pattern2	Tox	2.0nm	6.7nm	2.0nm	6.7nm
	Vth	0.25V, 0.40V	0.80V	0.40V	0.40V
Pattern3	Tox	2.0nm	6.7nm	2.0nm	2.0nm
	Vth	0.25V, 0.40V	0.80V	0.25V	0.40V
Pattern4	Tox	2.0nm	6.7nm	2.0nm	6.7nm
	Vth	0.25V, 0.40V	0.80V	0.25V	0.40V

23



24

