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(73) 가 가
가 가 가 가 4 1 - 1

(72) 가 가 2 - 1844 - 2 가 가

(74)

:

(54) /

DN / (1) 1 UP (2) , 2
(3) (3) . / (1) (2)
Co
(4) , (2) (3)
(5) (2) (3)

1 .
2 1 PLL .
3 1 .
4 (a) (c) .
5 2 .
6 A/D .
7 .
8 3 .
9 A/D .
10 .
11 .
12 4 .
13 .
14 (a) (c) 4 .
15 5 .
16 6 .
17 7 .
18 PLL .
19 PLL .
20 .
21 (a) (c) 가 .
22 .
23 () .
24 () 1/2 .

25 () 1/2 .

26 (a) (c) .

27 .

28 .

29 (a), (b) .

30 .

1: /

2:

3:

4:

5:

Co:

UP: 1

DN: 2

PLL .

7.5 가 , LD, CD - ROM, MD PD , CD - ROM
 가 DVD(Digital Video Disk)가 .

(lock)

PLL .

19 PLL (10) . PLL (10) (11), (12), (LPF)(13),
 (VCO)(14) (15)

(11) RIN FIN RIN (15) FIN UP, DN (

(11) RIN FIN 1, 2 UP, DN (

12) .

(12) (11) 1 2 UP, DN Co LPF

(13) Co UP, DN .

LPF(13) (12) Co Lo VCO(14) VCO(

14) LPF(13) Lo Fout , VCO(14)

Fout (15) VCO(14) Fout F

IN (11) .

22 (11) (11) 4 1 4 D (1 4 DF

)(21 24), (EOR) (25,26) (11) RIN FIN

1 2 UP, DN .

(11) L 1 UP , RIN FIN

H 2 DN .

23 25 (11) .

23 , RIN FIN (rising) , RIN, FIN

(11) 1 2 UP, DN .

, 24 RIN FIN RIN

1 FIN UP (lead). (11) 2 DN ,

, 25 RIN FIN RIN

1 FIN UP (come later). (11) 2 DN ,

20 MOS (, NMOS (12) P MOS (, PMOS)(TP1) N

1 L1 VSS 2 L2 (TP1, TN1) VDD

PMOS (TP1) VDD가 , NMOS (TN1)

1 NMOS UP (TN1) VSS가 , PMOS (TP1)

(TP1, TN2) (N1) (12) , Co

PMOS (TP1) L 1 UP (12) 1

L1 PMOS (TP1) LPF(13) (12) L

1 UP , LPF(13) 가 LPF(13)

. LPF(13) 가 , Lo .

NMOS (TN1) H 2 DN (12) LPF(13)
 NMOS (TN1) 2 L2 (12) H
 2 DN , LPF(13) . LPF(13)
 , (12) 1 2 UP, DN LPF(13) / , LPF(13)
 13) Lo / .

1 2 UP, DN RIN FIN . ,
 (12) 1 2 UP, DN L H / . ,
 (12) RIN FIN LPF(13) Lo /

23 , RIN FIN , (11)
 1 2 UP, DN (12) . ,
 (12) LPF(13) I(Co) (+) I(Co) (-) . ,
 , LPF(13) Lo V(Lo) . 19 VCO(14)
 LPF(13) Lo가 Fout .

25 , FIN RIN , (11) 2
 DN . , (12) LPF(13) UP , (12)
 . , LPF(13) Lo I(Co) (+) I(Co) (-)
 Lo V(Lo) . 19 VCO(14) LPF(13)
 Lo Fout .

24 , FIN RIN , (11) 2
 DN . , (12) LPF(13) UP , (12)
 (-) . , LPF(13) Lo I(Co) (+) I(Co)
 F(13) Lo Fout Lo V(Lo) . 19 VCO(14) LP
 , PLL (10) VCO(14) Fout

20 (12) MOS FET() (TP1,TN1)
 . , (12) (TP1,TN1) , 21 (a)
 , 1 2 L1, L2 1 2 (R1,R2) 가 가 .

Co VDD VSS 가 , 21 (b) (c) ,
 가 (R1,R2) (N1) 1 2 (R1,R2)
 2 (R2) (N1) 가 VDD 가 (가), 1 (R1)
 , (N1) 가 VSS 가 (

가), 1 (R1) 2 (R2) .

1 2 (R1,R2) 20 (TP1,TN1) - ,
 (TP1,TN2) (TP1,TN1) -
 가 , 가 , (TP1,TN1)

(TP1,TN1) PLL (10) .

, 21 (b) (N1) 가 , 19 RIN
 FIN (TP1,TN1)

1 2 UP, DN / .

, 20 NMOS (TN1) PMOS (TP1) , NMOS
 (TN1) PMOS (TP1) .

27 (TP1,TN1) / (N1) V(NI) , RIN
 FIN (TP1,TN1) / 27 , (

, ((N1) V(NI) VDD VSS)
 , PMOS (TP1) NMOS (TN1) 4:4 .

, (N1) , RIN FIN , 27
 , 2:6 .

, 19 LPF(13) Lo V(Lo) . VCO(14) LPF(13) Lo
 Fout .

PLL (10) , PLL (10) RIN FIN
 가 Fout , PLL (10) Fout (11)
 (12) (unbalance) , Fout 가

, 19 FIN RIN (11) 26
 (b) , 2 DN , NMOS (TN1)가 UP . ,
 PMOS (TP1)가 , NMOS (TN1)가 .

, 20 NMOS (TN1) PMOS (TP1) , NMOS
 (TN1) PMOS (TP1) , 27
 3:3, , 19 LPF(
 13) Lo V(Lo) . VCO(14) LPF(13) Lo
 Fout .

, PLL (10) FIN , Fout
 , PLL (10) Fout

19 FIN RIN (11) 26 (c)
 MOS (TN1)가 UP 1 (TP1)가 DN , N

20 NMOS (TN1) PMOS (TP1)
 NMOS (TN1) PMOS (TP1) , 27
 1:9,

19 LPF(13) Lo V(Lo) VCO(14) LPF(13)
 Lo Fout

PLL (10) Fout (overshoot)()

(N1) 가 , PMOS (TP1) NMOS (TN1)
 19 FIN RIN (12) 28
 9:1 , VCO(14) LPF(13) Lo
 Fout PLL (10)

19 FIN RIN (12) 28
 Fout , VCO(14) LPF(13) Lo
 , PLL (10) Fout

PLL 28 (30)가 (30) 9 1 9
 (30a 30i) 2 3 (30b,30c) 1 (31) , 4
 5 (30d,30e) 2 (32)

(30) 29 (a) , RIN FIN
 1 UP (30) 20 2 (1)
 2) DN NMOS (TN1) DN 가

(30) 29 (b) , RIN FIN
 2 DN (30) 1
 UP

(30) RIN FIN 1
 2 UP, DN 20 (12) 1 2 UP, DN 1
 / , PLL Fout 30 , Fout 가 /

(30) FIN 1 UP ,
 2 DN Lo 1 2 UP, DN (12)
 , LPF(13) Lo VCO(14)
 Fout

20 (N1) V(NI)가 , PMOS (TP1)
 , (12) LPF(13) Lo , VCO(14) LP
 F(13) Lo , Fout , PLL (10)
 Fout , , 가 .
 (balance)

PLL

1 (1) / (1), (4), (5)
 DN (1) 1 UP (3) , / (2) , 2 (2)
 Co (3) (4) (2) (3) ,
 (2) (3) (5) (2) (3) ,
 (balance)

1 1 , , 가 , 가

2 1 , , 가 ,

3 1 , ,

4 1 , , 가 , 가

5 1 , , 가 ,

6 1 , , , .

7 1 1 6 가 1 2 , , 2 1 , , 1

8 7 1 1 1 1 1 2 2 2 1 2 1 2

9 7 1 1 1 1 1 2 2 1 1 2 1 1 2

10 1 6 1 2 1 2 1 2 1 2 1

11 10 2 2 2 2 2

12 10 1 2 1 1 2 1 2 1 2 1 2

13 10 1 1 1 2 1 2 1 1 2 1 2 1 2

, PLL , 1 2
 1 2 , 1 2
 , / , 1 2
 , 2 , 1 1
 , 1 3 , 2 1 2
 , 2 4 , 1 2
 3 , 3 , 1 2
 , .

, PLL , 1 2
 1 2 , 1 2
 2 , / , 1
 2 , 1
 2 1 2 , 1
 , A/D , 1
 , 2 , 2
 , 1 , 2
 , .

, PLL , 1 2
 1 2 , 1 2
 , / , 1 2
 1 2 , 1 1 2
 1 , 2 1 2 3 2
 , 1 가 , 3 1 2 2
 1 , 3 2 , 2
 , 4 , 3 1
 , 4 2 , 1
 , .

, PLL , 1 2

1 2 , 1 2
 , 1 2 , 1 2
 / , , 1 2
 1 1 2 , 1
 2 , 1 1 1 , 1
 , 1 1 , 2 2 , 1 1 1 ,
 2 , 2 , 1 3 1
 , 1 1
 2 , 1 , ,
 2 2 , ,

PLL , 1 2
 1 2 , 1 2 , 1 2
 , 1 2
 / , 1 1
 , 2 3 1 1 1 1 1 2 ,
 2 , 1 , 2
 2 2 , 1 , 2
 1 , 1 2 ,
 , 1 2 ,

PLL , 1 2
 1 2 , 1 2 , 1 2
 , 1 2
 / , 1 1
 , 1 2 1 2 1 2 1 1
 , 1 1 , 2 3 1 1 ,
 1 1 2 2 , 1 1 1 ,
 2 2 2 , 2 , 1 1
 , 2 , 1 2 ,

(3) 1 , Co (2)
(4) (5) .

가 , 가 , .

2 , 가 , ,
. 가 .

3 , , ,
. , .

4 , ,
. , .

가 , 가 , ,
. , .

5 , , ,
. , .

가 , 가 , ,
. , .

6 , , ,
. , .

7 , 1 2 가 1
. , 가 1

2 , 2 , 1
. , .

8 , 1 , ,
. , .

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

9 , 1 1 , ,
 1 2 1 2 , 1 2 ,
 1 1 , 2 .

10 , 1 1 ,
 2 가 2 가 , 2 2
 1 , 2 가 . , 2 2

11 , 2 2 2 .
 2 2 , .

12 , 1 1 , ,
 1 2 1 2 , 1 , 2
 , 2 2 , 1 2

13 , 1 1 , ,
 1 2 2 , 1 2 2 , 2
 , .

, PLL 가 ,
 , 1 2 4 .

2 1 PLL (40) . PLL (40) (11), (41), (LPF)
 (13), (VCO)(14) (15) .

(11) RIN FIN RIN (15) FIN UP, DN
 (41) . 1 2

F(13) (41) (11) Co 1 2 UP, DN , Co LP
 . UP, DN .

LPF(13) (41) Co Lo VCO(14) VCO(14)
 14) LPF(13) Lo Fout (15) (15) VCO(14) Fout , VCO(14)
 Fout (11)
 FIN (41)
 3 1 (41)
 (41) 1 3 P MOS (PMOS) (TP1 TP3), 1 3 N MOS
 (NMOS) (TN1 TN3) (Rc)
 1 PMOS (TP1) VDD , 1 NMOS (TN1)
 1) 1 NMOS (TN1) VSS , 1 PMOS (TP1)
 1 NMOS (TN1) (N1) (41)
 Co
 1 PMOS (TP1) / 1 PMOS (TP1)
 PI) VDD (N1) 2 LPF(13) I(Co) LPF(13)
 , I(Co)
 , 1 PMOS (TP1) LPF(13) (N1)
 , Co , LPF(13) Co Lo
 , Lo
 1 NMOS (TN1) / 1 NMOS (TN1)
 TN1) 2 LPF(13) (N1) VSS I(Co) , LPF(13)
 , 1 NMOS (TN1) LPF(13) , LPF(13)
 Lo , Lo
 / 1 PMOS (TP1) 1 NMOS (TN1) LPF(13)
 LPF(13) / (C/D)(42) , 1 PMOS (TP1)
 , 1 NMOS (TN1) LPF(13)
 (N1) 2 PMOS (TP2) , (N1) 2 NMOS (TN2)
 2 PMOS (TP2) VDD , (Rc) 1
 (Rc) 2 2 NMOS (TN2) , 2 NMOS (TN2)
 VSS , 2 PMOS (TP2) (Rc) 2 NMOS
 (TN2) VDD VSS
 (N1) , Co 2 PMOS, NMOS (TP2, TN2) 가 .
 (TP2, TN2) FET 가 가
 가가
 (TP2, TN2) Co가 가 . 2 PMOS (TP2)
 VDD가 , 2 PMOS (TP2) Co VDD
 가가

, 2 NMOS (TN2) VSS가 , 2 NMOS (TN2)
 Co

가 4 (a) . 2 PMOS (TP2) (Rp) , 2 NMOS
 (TN2) (Rn) (N2,N3) VDD VSS
 (Rp,Rc,Rn) V1,V2 2 PMOS, NMOS (TP2,TN2) 가 (Rp, Rn) (N
 2,N3) Co

VDD VSS (Rc)

Co VDD VSS (=1/2(VDD+VSS))
 2 PMOS (TP2) - 2 NMOS (TN2) - VDD
 (N2) (TP2,TN2) (N3) VSS

Co VDD 가 () , 4 (c)
 , 2 PMOS (TP2) 2 NMOS (TN2)
 (N2,N3) V1, V2(V1c,V2c) Co
 1 2 V1a, V2a

Co VSS 가 () , 4 (b)
 , 2 PMOS (TP2) 2 NMOS (TN2)
 (N2,N3) V1,V2(V1b,V2b) Co
 V1a, V2a

, 2 PMOS, NMOS (TP2,TN2) (Rc) Co
 VDD 가 VSS 가 (43)
 Co V1(V1a V1c), V2(V2a V2c)

3 , 2 PMOS (TP2) (Rc) (N2) 3 NMOS
 (TN3) 1 NMOS (TN1) . 3 NMOS (TN3)
 2 DN 가

3 NMOS (TN3) 2 DN () /
 , 3 NMOS (TN3) 가 H 2 DN
 3 NMOS (TN3) (N2) 1 NMOS (TN1)
 , 1 NMOS (TN1) , 2 DN H , (N2) 가

2 NMOS (TN2) (Rc) (N3) 3 PMOS (TP3) 1 PMO
 S (TP1) . 3 PMOS (TP3) 1 UP 가

3 PMOS (TP3) 1 UP () /
 , 3 PMOS (TP3) 가 L 1 UP
 , 1 PMOS 3 PMOS (TP3) (N3) 1 PMOS (TP1)
 , 1 PMOS (TP1) 1 UP L (N3) 가

1 PMOS, NMOS (TP1, TN1) 가 V1, V2 , 2
 LPF(13) / 1 2 V1, V2 Co
 , 1 V1 2 PMOS (TP2) V1, V2 Co
 VDD 2 V2 2 NMOS (TN2)
 - , Co VSS

1 PMOS (TP1) Co VSS 가
 , (43) 2 , 1 PMOS (TP1) ()
 , 1 NMOS (TN1) VDD 가 ,
 , 1 NMOS (TN1) () (43)
 1 V1

3 PMOS, NMOS (TP3, TN3) (43) C/D (42)
 / (44)

(41) Co

[Co V(NI)가 VDD VSS]

1 , 2 PMOS (TP2) - 2 NMOS (TN2)
 , 2 PMOS (TP2) , (Rp) 2 NMOS (T
 N2) (Rn) (43) VDD
 (N2) 1 V1 , (N3) 2 V2 VSS

1 (TP1, TN1) 1 2 V1, V2
 , 1 (TP1, TN1) , /

(41) 1 2 UP, DN LPF(13)
 / LPF(13) Lo 2 VCO(14) LPF(
 14) Lo Fout /

[Co V(NI)가 VSS 가]

2 , 2 PMOS (TP2) - 2 NMOS (TN2)
 , (43) 1 1 2 V1b, V2b(4 (b))
 (44) 1 V1b 1 NMOS (TN1) 가 , 2
 V2b 1 PMOS (TP1) 가

(44) 1 PMOS (TP1) 1 NMOS (TN1)
 , 1 PMOS (TP1) , 1 NMOS (TN1)

12) 가 (41) (41) (

2 RIN FIN (41)
 1 2 UP, DN , LPF(13) /
 , LPF(13) Lo V(Lo) (41) /

2 VCO(14) LPF(13) Lo Fout
 , PLL (40) PLL (10) 가 가 .

RIN FIN (41) 1 2
 UP, DN / , 26 (b) 1
 UP 2 DN , C/D (42) 1
 V(Lo) / (41) , LPF(13) Lo

Fout , PLL (40) Fout

RIN FIN (41) 1 2
 UP, DN / , 26 (c) , 1
 UP 2 DN , C/D (42) , LPF
 (13) Lo V(Lo)가 (41) (12)

Fout 가 , PLL (40)
 Fout , PLL (10)

[Co V(NI)가 VDD 가]

3 , 2 PMOS (TP2) - 2 NMOS (TN2) -
 (43) 1 V1c 1 2 V1c, V2
 c(4 (c)) (44) 1 NMOS (TN1)
 가 , 2 V2c 1 PMOS (TP1) 가 .

(44) 1 NMOS (TN1) 1 PMOS (TP1)
 , 1 PMOS (TP1) , 1 NMOS (TN1)

가 , (41) (12)
 , (41)

, 2 RIN FIN (41)
 1 2 Up, DN , LPF(13) /
 , LPF(13) Lo V(Lo) (41) /

, 2 VCO(14) LPF(13) Lo Fout
 , PLL (40) PLL (10) 가 가 .

, RIN FIN (41) 1 2
 UP, DN / , 26 (b) , 1
 UP 2 DN (42)
 PF(13) Lo V(Lo)가 (41) (12) , L

Fout Fout 가 , PLL (40)
 Fout PLL (10)

, RIN FIN (41) 1 2
 UP, DN / , 26 (c) ,
 1 UP 2 DN (42)
 V(Lo) , LPF(13) Lo

, Fout , PLL (40) Fout
 , 1 ,

(1) (43) 가 (N1) 1 2 V1, V2
 (44) 1 2 UP, DN , 2 V2 C/D (42) 1 PMOS
 (TP1) 가 , 1 V1 1 NMOS (TN1) 가
 , Co , 1 NMOS (TN1) 1 PMOS (TP1)
 , (41) (41) (12)

, Co , 1 PMOS (TP1) 1 NMOS (TN1)
 , (41) (41) (12)

(2) (41) RIN FIN
 , (41) , Co
 , VCO(14) Fout , PLL
 (40)

(3) RIN FIN , (41) 1 2
 UP, DN LPF(13) Lo V(Lo) (41) 1 2 UP, DN
 , PLL (40) Fout Fout

S , 3 3 PMOS (TP3), 3 NMOS (TN3) , NMO
 (N3) 1 PMOS (TP1) , PMOS (N2)
 1 NMOS (TN1) , PMOS
 NMOS 1 2 UP, DN 가 가 .

2 5 7 .
 5 (51) (51) 2 PLL (10)
 (41) .

(51) 1 3 PMOS (TP11 TP13), 1 3 NMOS (TN11 TN13), A/D(
 /) (52) (53) .

1 PMOS (TP11) VDD , 1 NMOS (TN11)
 TP11) 1 NMOS (TN11) VSS 1 PMOS (TN11) (
 1 NMOS (TN11) Co (N1) (51) ,

1 PMOS (TP11) 2 (11) 1 UP
 1 PMOS (TP11) 1 UP (N1) / 1 PMOS
 (TP11) VDD (N1) 2 LPF(13) I(Co) . LPF(1
 3) , I(Co) .

1 PMOS (TP11) LPF(13) , LPF(13)
 Lo , Lo .

1 NMOS (TN11) 2 (11) 2 DN
 1 NMOS (TN11) 2 DN (N1) / 1 NMO
 S (TN11) 2 LPF(13) VSS I(Co) .
 , LPF(13) .

1 NMOS (TN11) LPF(13) , LPF(13)
 Lo , Lo .

1 PMOS (TP11) 1 NMOS (TN11) LPF(13)
 / 1 / (C/D)(54) , 1 PMOS
 (TP11) LPF(13) 1 , 1 NMOS (TN11) LPF(13)
 1 .

1 PMOS (TP11) 2, 3 PMOS (TP12,TP13)가
 1 (TP1) (N1) 2 (TP12) , 2
 (TP2) 3 (TP13) 3 (TP13) VD
 D가 가 .

2 PMOS (TP12) 1 UP , 2 PMOS (TP12,TP13)가
 TP12) 1 UP , 1 PMOS (TP11) /

3 PMOS (TP13) (53) 1 S1
 3 PMOS (TP13) 1 S1 /

2 3 PMOS (TP12,TP13)가 , 2, 3 (TP12,TP13)
 VDD 2 LPF(13) I(Co) . LPF(13)
 I(Co)

, 2 3 PMOS (TP12,TP13) LPF(13) , LPF(13)
 Lo , Lo

1 NMOS (TN11) 2 3 NMOS (TN12,TN13)가
 , 1 (TN11) (N1) 2 (TN12) , 2
 (TN12) 3 (TN13) 3 (TN13)
 VSS가 가 .

2 NMOS (TN12) 2 DN , 2 NMOS
 (TN12) 2 DN , 1 NMOS (TN11) /

3 NMOS (TN13) (53) 2 S2가
 3 NMOS (TN13) 2 S2 /

2 3 NMOS (TN12,TN13)가 , 2 3 (TN12,TN13)
 3) 2 LPF(13) VSS I(Co) . LPF(13) I(Co)
 가 .

, 2 3 NMOS (TN12,TN13) LPF(13) , LPF
 (13) Lo , Lo

, 2 3 PMOS (TP12,TP13) 2, 3 NMOS (TN12,TN13) LPF(13)
 / 2 C/D (55) , 2 3 PMOS (TP
 12,TP13) LPF(13) 2 , 2 3 NMOS (TN12,TN13)
 LPF(13) 2

(N1) A/D (52) . A/D (52) Co가 .

6 , A/D (52) ((R11 R14)
 (R11 R14) VDD VSS

1 R14) 1 3 V11 V13 VDD VSS (R1

A/D (52) 1 3 V11 V13 Co V(Co) , D2 D0
 . A/D (52) V11 V13 D2 D0 「1」 「0」 .

「000」 , Co VDD 1 V11 , A/D (52)
 D2 D0 Co 1 V11 2 V12
 , A/D (52) 「100」 D2 D0 Co 2
 V12 3 V13 , A/D (52) 「110」 D2 D0
 . , Co 3 V13 VSS , A/D (52) 「
 111」 D2 D0 .

5 (53) , A/D (52) D2 D0 (53)
 D2 D0 , D2, D0 1 2 S1, S2 .

「0」 , D2 Co Co V(Co)가 VDD 1 V11 「0」
 Co D2, L 1 V11 VSS 「1」 . ,
 VDD 가

0」 , D0 Co Co V(Co)가 VDD 3 V13 「
 , 「1」 DO, H 2 V13 S2 Co 「1」 .
 VSS 가

「0」 , A/D (52) (53) , Co VDD 가
 VSS 가 1 2 S1, S2 .

5 (TP13) 「1」 (H) 1 S1 3 PMOS (TP13) 가 . 3 PMOS
 S1 , L 1 S1 , 「0」 (L) 1
 , 3 PMOS (TP3) Co VDD 가

「1」 (H) S2 3 NMOS (TN(13)) 가 . 3 NMOS (TN(13))
 H 2 S2 , 「0」 (L) 2 S2
 , 3 NMOS (TN13) Co VSS 가 .
 (51) Co .

[Co 1 V1 3 V3]

1 , A/D (52) 「110」 「100」 D2 D0 (53)
 D2 D0 H 1 S1 L 2 S2 . 1 2
 S1, S2 3 (TP13, TN13) . , 2 C/D (55)

S, NMOS (51) 1 C/D (54) (N1) / 1 PMO
(TP11,TN11)

[Co VDD 1 V1]

2 , A/D (52) 「000」 D2 D0 (53) D2 D0
L 1 2 S1,S2 . 3 PMOS (TP13) L 1
S1 , 3 NMOS (TN13) L 2 S2
, 2 C/D (55)

(51) 1 2 C/D (54,55) , 1 C/D (54)
(51) Co VDD 가
(12) ()
(51) 2 C/D (55)

[Co 3 V3 VSS]

3 , A/D (52) 「111」 D2 D0 (53) D2 D0
H 1 2 S1, S2 . 3 PMOS (TP13) H 1
S1 , 3 NMOS (TN13) H 2 S2
, 2 C/D (55)

(51) 1 C/D (54) , 1 2 C/D (54,55)
(51) Co VSS 가
(12) () (51) 2
C/D (55)

(1) 1 2 C/D (54,55) , 1 C/D (54) 1 2 UP, DN
/ , 2 C/D (55) , Co Co
(51) 가

, 3 8 11

, 2

8 (51a) (51a) 2 PLL (10)
(41)

(51a) 1 5 PMOS (TP11 TP15), 1 5 NMOS (TN11 TN15), A/D
(/) (52a) (53a)

1 3 PMOS (TP11 TP13) 1 3 NMOS (TN11 TN13) 2
, 1 PMOS (TP11) 1 NMOS (TN11) 1 / (
1 C/D)(54) . 2 3 PMOS (TP12,TP13) 2 3 NMOS (TN12,
TN13) 2 C/D (55)

1 PMOS (TP11) 4, 5 PMOS (TP14,TP15)가
 , 1 (TP1) (N1) 4 (TP14) , 4
 (TP2) 5 (TP15) 5 (TP15)
 VDD가 가

4 PMOS (TP14) 1 UP , 4 PMOS (TP14) 1 UP
 TP14) 1 (TP14) UP , 1 PMOS (TP11) /

5 PMOS (TP15) (53a) 1 S3
 5 PMOS (TP15) 1 S3 /

4, 5 PMOS (TP14,TP15)가 , 4, 5 (TP14,TP15)
 VDD 2 LPF(13) I(Co) . LPF(13)
 I(Co)

, 4, 5 PMOS (TP14,TP15) LPF(13) , LPF(13)
 , Lo , Lo

1 NMOS (TN11) 4, 5 NMOS (TN14,TN15)가
 , 1 (TN11) (N1) 4 (TN14) , 4
 (TN14) 5 (TN15) 5 (TN15)
 VSS가 가

4 NMOS (TN14) , 4 DN , 4 NMOS (TN14) 4 DN
 14) 4 (TN14) DN 1 NMOS (TN11) /

5 NMOS (TN15) (53a) 4 S4가
 5 NMOS (TN15) 4 S4 /

4 5 NMOS (TN14,TN15)가 , 4, 5 (TN14,TN15)
 2 LPF(13) VSS I(Co) . LPF(13) I(Co) 가

, 4, 5 NMOS (TN14,TN15) LPF(13) , LPF(13)
 13) Lo , Lo

4, 5 PMOS (TP14,TP15) 4, 5 NMOS (TN14,TN15) LPF(13)
 / 3 / (C/D)(56) , (51a)
 1 3 C/D (54 56)

(N1) A/D (52a) . A/D (52a) Co가

9 , A/D (52a) (5) (R11 R15)
 . (R11 R15) VDD VSS
 VDD VSS (R1
 1 R15) 1 3 V11 V14

A/D (52a) 1 3 V11 V14 Co V(Co) , D3 D0
 . A/D (52a) 1 3 V11 V14 D3 D0 「1」 「0」

「0000」 Co VDD 1 V11 , A/D (52a) V
 12 , A/D (52a) 「1000」 Co 1 V11 2 V
 2 V12 3 V13 , A/D (52a) 「1100」 Co D2
 D0 (52a) 「1110」 Co 3 V13 4 V14 , A/D
 VSS , A/D (52a) 「1111」 Co 4 V14

10 (53a) , A/D (52a) D3 D0 (53a)
 D3 D0 , D3, D2, D1, D0 1, 3, 4, 2 S1, S3,
 S4, S2

D3 Co V(Co)가 VDD 1 V11 「0」
 , Co V(Co)가 1 V11 「1」
 D2, 1 S1 Co VDD 1 V11

D2 Co V(Co)가 VDD 2 V12 「
 0」 , Co V(Co)가 2 V12 「1」
 , 「0」 D2, L 2 S2 Co VDD 2
 V12

D1 Co V(Co)가 VDD 3 V13 「
 0」 , Co V(Co)가 3 V13 「1」
 , 「1」 D1, H 4 S4 Co VDD 3
 VSS V13

D0 Co V(Co)가 VDD 4 V14 「
 0」 , Co V(Co)가 4 V14 「1」
 , 「1」 D0, H 2 S2 Co VDD 4
 VSS V14

, A/D (2a) (53a) , Co VDD 가 가
 VSS 가 가 , 1 4 S1 S4

8 , 1 S1 3 PMOS (TP13) 가 3 PMOS
 (TP13) 「1」 (H) 1 S1 , 「0」 (L) 1
 S1

2 S2 3 NMOS (TN13) 가 3 NMOS (TN13) 「1」 (
 H) 2 S2 , 「0」 (L) 2 S2

3) 3 S3 5 PMOS (TP15) 가 . 5 PMOS (TP15) 「1」(H
 , 「0」(L) 3 S3

4) 4 S4 5 NMOS (TN15) 가 . 5 NMOS (TN15) 「1」(
 H) 4 S4 , 「0」(L) 4 S4

(51a) Co

[Co 2 V2 3 V3]

1 , A/D (52) 「1100」 D3 D0 (53) D3 D0
 H 1, 3 S1, S3 L 2, 4 S2, S4 . 1 4
 S1 S4 3 (TP13,TN13) , 2 3 C/D
 (55,56)

OS, NMOS (51a) 1 C/D (54) (N1) / 1 PM
 (TP11,TN11)

[Co 1 V1 2 V2]

2 , A/D (52) 「1000」 D3 D0 (53) D3 D0
 , H 1 S1 L 2 4 S2 S4 . 3 PMOS
 (TP13) H 1 S1 , 5 PMOS (TP13) L
 3 S3 . 3, 5 NMOS (TN13,TN15) L 2,
 4 S2, S4 , 2 C/D (55) . 3 C/D (56)

(51a) 1, 3 C/D (54,56) , 1 C/D (54)
 . , 1 PMOS (TP11) 5 PMOS (TP1

5)

(51a) Co VDD 가 , (12)
 () , (51a) 3 C/D (56)

[Co VDD 1 V1]

3 , A/D (52) 「0000」 D3 D0 (53) D3 D0
 L 1 4 S1 S4 . 3, 5 PMOS (TP13,TP15) L
 1, 3 S1,S3 , 3, 5 NMOS (TN13,TN15) L 2,
 4 S2, S4 . 2 3 C/D (55,56)

(51a) 1 3 C/D (54 56) , 1 C/D (54)
 . , 1 PMOS (TP11) 3 5 PMOS
 (TP13,TP15)

(51a) Co VDD 가 (12)
 (55,56) () (51a) 2 3 C/D

(51a) 2 2 C/D (55)
 (51a) Co

[Co 3 V3 3 V4]

4 , A/D (52) 「1110」 D3 D0 (53) D3 D0
 H 1, 3 4 S1, S3, S4 , L 2 S2 3,
 5 PMOS (TP13,TP15) H 1 S1 3 NMOS
 (TN13) L 2 S2 , 5 NMOS (TN15) H
 4 S4 , 2 C/D (55) 3 C/D (56)

(51a) 1 C/D (54) , 1, 3 C/D (54,56)
 15) 1 NMOS (TN11) 5 NMOS (TN

(51a) Co VSS 가 (12)
 () (51a) 3 C/D (56)

[Co 4 V4 VSS]

5 , A/D (52) 「1111」 D3 D0 (53) D3 D0
 H 1 4 S1 S4 , 3, 5 PMOS (TP13,TP15) H
 1, 3 S1,S3 , 3 5 NMOS (TN13,TN15) H
 2, 4 S2,S4 , 2 3 C/D (55,56)

(51a) 1 C/D (54) , 1 3 C/D (54 56)
 (TN13,TN15) 1 NMOS (TN11) 3, 5 NMOS

(51a) Co VSS 가 (12)
 () (51a) 2 3 C/D
 (55,56)

(51a) 4 2 C/D (55)
 (51a) Co

11 1 2 UP, DN /
 11 , (51a) (12)

(12) , VSS (5)
 , VDD (11)
 VSS (11) VDD ()
 11) , / 『1』 .
 , 3 , 1 2 , .
 (1) (51a) , 1 3 C/D (54 56) , 1 C/D (54) 1 2 U
 P, DN (56) , 2 3 C/D (55,56) , (51a) Co 가
 , 3 C/D (56) , 2 3 C/D (55,56) , (51a) Co 가
 , 2 3 , A/D (52,52a), (53,53a) 1
 , 2 3 , (53,53a)
 , 2 3 , A/D (52,52a)
 , 4 12 14 .
 , 1 .
 12 (61) .
 (61) 1 PMOS, NMOS (TP11,TP11) / (54)
 1 (TP11,TN11) (N1) 2 PMOS, NMOS (TP12,TN12)가
 2 PMOS (TP21) (TP21) , 2 PMOS
 (TP21) - (N1) V(NI) VDD
 2 NMOS (TN21) (TN21) , 2 NMOS
 (TN21) - (N1) V(NI) VSS
 2 PMOS (TP21) 가 (N21) 1 (OP1)
 1 (OP1) (N1)
 2 NMOS (TN21) 가 (N22) 2 (OP2)
 2 (OP2) (N1)
 13 , 1 (OP1) (62) (63)
 (63) IP IM
 , S11 .

, IM IP V V NMOS
 (TN23b) 가 I 가 . 가 I , V NMOS
 (TN23a) 가 I . , PMOS (TP23b) 가
 I . (63) PMOS (TP23b) (2 I)
 . (63) 1 S11 .

3) , 1 IP IM V V (6
 S11 . 2 (OP2) 1 (OP1)

3 PMOS , 1 (OP1) (N21) (N1) 1 S11
 (TP22) . , 2 (OP2) (N22) (N1)
 2 S12 3 NMOS (TN22) .

(N1) (N21,N22) Co VDD, VSS
 . , 1 2 (OP1,OP2) 2 PMOS, NMOS (TP21,TN21) Co
 VDD 가 VSS 가 (64)

1 S11 Co VDD 가 , 1
 S11 (OP1) . , 1 (OP1) 가 (OP1) (VDD 가)
 1 S11 .

, Co VSS 가 , 1 (OP1)
 (OP1) . , 1 가 (OP1) 1 S11 , 1
 (VSS 가) 1 S11 .

2 S12 Co VDD 가 , 2
 S12 (OP2) . , 2 (OP2) 가 (OP2) (VDD 가)
 2 S12 .

, Co VSS 가 , 2 (OP2)
 (OP2) . , 2 가 (OP2) 2 S12 , 2
 (VSS 가) 1 S12 .

3 PMOS (TP22) VDD , 1
 PMOS (TP11) .

3 PMOS (TP22) 1 S11 S11 . 3 PMOS (TP22)
 1 S11 , 1 S11 가 .

3 PMOS (TP22) 1 PMOS (TP11) 가 1 UP
 P 3 PMOS (TP22) , 3 PMOS (TP22) 가 , 1 U
 VDD , L .

1 PMOS (TP11) 1 UP , 1 PMOS (TP1
 1) 1 UP 가 , 3 PMOS
 (TP22) 1 S11 C/D 1 PMOS (TP11)

3 NMOS (TN22) VDD , 1 NMO
 S (TN11)

3 NMOS (TN22) 2 S12가 3 NMOS (TN22) 1
 S12 , 1 S11 가 .

3 NMOS (TN22) 1 NMOS (TN11) 가 2 DN
 , 3 NMOS (TN22) 가 , 2 DN
 3 NMOS (TN22) VSS 가 , H .

1 NMOS (TN11) 2 DN , 1 NMOS (TN
 11) 2 DN 가 , 3 NMOS
 (TN22) 2 S12 C/D 1 NMOS (TN11)

, 3 PMOS, NMOS (TP22, TN22) C/D (54) / (65)

, 1 2 (OP1, OP2) Co VDD VSS
 (=1/2(VDD+VSS)) , 1 PMOS, NMOS (TP11, TN11) /
 1 2 S11, S12 .

, (61) 14 .

[Co VDD VSS]

1 , 14 (a) , 1 2 PMOS (TP11, TP21) 1 2 NMOS
 (TN11, TN21) 가 . (N21, N1, N22) ,
 VDD VSS , 14
 (a) 가 .

, 1 2 (OP1, OP2) 1 2 S11, S12 3 PMOS,
 NMOS (TP22, TN22) 가 1 2 S11, S12 가
 , 1 PMOS, NMOS (TP11, TN11) 가

[Co V(NI)가 VSS 가]

2 , 14 (b) , 1 2 PMOS (TP11, TP21)
 , 1 2 NMOS (TN11, TN21) , (N21, N1)
 (N1, N22) .

1 (OP1) (N21, N1) 1 S11 2
 (OP2) (N1, N22) 2 S12 .

3 PMOS (TP22) 1 S11 가 , 3 P
MOS (TP22) 1 S11 , 1 UP L
, 1 PMOS (TP11)

, 3 NMOS (TN22) 2 S12 가 ,
3 NMOS (TN22) 2 S12 , 2 DN
H , 1 NMOS (TN11)

, 가 , (61) (12)
, (61)

[Co V(NI)가 VDD 가]

3 , 14 (c) , 1 2 PMOS (TP11,TP21)
1 2 NMOS (TN11,TN21) , (N21,N1)
(N1,N22)

1 (OP1) (N21,N1) 1 S11 . 2
(OP2) (N1,N22) 2 S12

3 PMOS (TP22) 1 S11 가 , 3
PMOS (TP22) 1 S11 , 1 UP L
, 1 PMOS (TP11)

, 3 NMOS (TN22) 2 S12 가 , 3
NMOS (TN22) 2 S12 , 2 DN H
, 1 NMOS (TN11)

, 가 , (61) (12)
, (61)

, 4 , (61) 1 PMOS, NMOS (TP11,TN11)
, 1 PMOS, NMOS (TP11,TN11)

, 5 15

, 2

15 (71)

(71) 1 3 PMOS (TP11 TP13), 1 3 NMOS (TN11 TN13), 1
2 (OP1,OP2) , 1 3 PMOS (TP11 TP13) 1 3 NMOS
(TN11 TN13) 2 , 1 2 (O
P1,OP2)

, 1 PMOS (TP11) 1 NMOS (TN11) 1 / (1 C/D)(54)
 , 2 3 PMOS (TP12,TP13) 2 3 NMOS (TN12,TN13)
 2 C/D (55)

1 (OP1) 1 PMOS (TP11) , (N1)
 1 (OP1) 1 PMOS (TP11) 1 (OP1)
 2 / (C/D)(55) 3 PMOS (TP13)

2 (OP2) 1 NMOS (TN11) , (N1)
 1 (OP2) 1 NMOS (TN11) 2
 (OP2) 2 C/D (55) 3 NMOS (TN13)

1 (OP1) 1 PMOS (TP11) - 1
 S11 , 1 (OP1) (N1) V(NI) VDD
 1 S11 3 PMOS (TP13)

, Co VDD 가 , 1 (OP1)
 (OP1) , 1 가 (OP1) 1 S11 , 1
 가 (VSS 가) 1 S11

, Co VSS 가 , 1 (OP1)
 (OP1) , 1 가 (OP1) 1 S11 , 1
 가 (VDD 가) 1 S11

3 PMOS (TP13) 1 S11 , 2 C/D (5
 5) Co

2 (OP2) (N1) V(NI) 1 (TP11) VSS
 , 2 S12 3 NMOS (TN13)

3 NMOS (TN13) 2 S12 , 2 C/D (
 55) Co

, 1 2 (OP1,OP2) Co VDD 가 VSS
 가 2 C/D (55) 1 2
 S11, S12 /

2 C/D (55) Co VDD 가 ,
 (71)
 (71) (12)

, 2 C/D (55) Co VSS 가 , (71)
 (71) (12)

, 1 2 (OP1,OP2) Co VDD VSS
(=1/2(VDD+VSS)) , 1 PMOS, NMOS (TP11,TN11) /
1 2 S11, S12 .

, 5 (71) 1 PMOS, NMOS (TP11,TN11)
, 2 C/D (55) .

, 6 16 .

, 4 .

16 (91) .

(91) 1 2 PMOS (TP11,TP22), 1 2 NMOS (TN11,TN22), (R21,R22), 1 2 (92,93), (94) , 1 2 PMOS (TP11,TP22) 1 2 NMOS (TN11,TN22) 4 , (TP11,TP22) 1 2 NMOS (TN11,TN22) ,

1 PMOS (TP11) - (R21) 1 (92) 가
. 1 (92) - (I - V) , (R21)
1 S31 . , (R21) 1 (92) ()

(R21) 1 PMOS (TP11) , , 1
(92) 1 C/D (54) 1 S31 .

1 NMOS (TN11) - (R22) 2 (93) 가
. 2 (93) - (I - V) , (R22)
2 S32 .

(R22) , 1 NMOS (TN11) , ,
2 (93) 1 C/D (54) () 2 S32 . ,
(R22) 2 (93) () .

(94) 1 S31 , 2 S32가
(94) S31, S32 , S21 .

, (94) 1 S31 2 S32 , H
, L S21 . , (94) 1 S31 2 S32

1 2 S31, S32 1 C/D (54) / ,
(94) H S21 , L
S21 . , (R21, R22), 1 2 (92,93) (94)
H L S21 / .

S21 2 PMOS, NMOS (TP22,TN22) . 2 PMOS, NMOS
(TP22,TN22) S21 (TP22,TN22) 1 PMO
S, NMOS (TP11,TN11) . 1 (TP11,TN11)

가 , / .

1 , 2 PMOS (TP22) H S21
 UP L , 1 PMOS UP가 , 1 PMOS
 (TP11) , 1 PMOS (TP11)

, 2 NMOS (TN22) H S21 , 2
 DN H , 1 NMOS DN , 1 NMOS
 (TN11) , 1 NMOS (TN11)

, 2 PMOS (TP22) L S21 , 1
 UP L , 1 PMOS UP가 , 1 PMOS (TP11)
 (12) (TP11) (91)

2 NMOS (TN22) L S21 , 2
 DN H , 1 NMOS DN , 1 NMOS (TN11)
 (12) (TN11) (91)

S, NMOS (91) , 1 PMOS, NMOS (TP11,TN11) 1 PMO
 (TP11,TN11)

, 7 17

, 2, 6

17 (101) (101) 2 2
 C/D (55) , 7 /

, (101) 1 3 PMOS (TP11 TP13), 1 3 NMOS (TN11 TN13),
 (R1,R22), 1 2 (92,93) (94)

1 PMOS, NMOS (TP11,TN11) 1 / (C/D) (54) 2 3 P
 MOS (TP12,TP13) 2 3 NMOS (TN12,TN13) 2 C/D (55)

(R21) 1 (92) 1 1 PMOS (TP11)
 () , 1 S31 (R22) 2 (93)
 2 1 NMOS (TN11) , 2

S32

(94) 1 2 S31, S32 S21
 , (94) 1 S31 2 S32 , L
 S21 , (94) 1 S31 2 S32
 , H S21

1 2 S31, S32 1 C/D (54) /
 , (94) H S21 , L
 S21 , (R21,R22), 1 2 (92,93) (94)
 H L S21 /

(94)
 3 PMOS (TP13) H S21 3 PMOS, NMOS (TP13,TN13)
 3) H S21 , 2 C/D (55) , 3 NMOS (TN1)

(101) 1 C/D (54) , 1 2 C/D (54,55)
 NMOS (TN11,TN13) (101) Co 가 , 1, 3
 (12) , (101)

3 PMOS (TP13) L S21 , 3 NMOS (TN1)
 3) L S21 , 2 C/D (55)
 (101) 1 2 C/D (54,55) , 1 C/D (54)
 (TP11,TP13) (101) Co 가 , 1, 3 PMOS
 (12) , (101)

1 2 C/D (54,55) , 3 1 3 C/D (54 5)
 6) C/D

(41 101) PLL PLL
 18

PLL (110) (11), (41), (LPF)(13), (VCO)(1
 4) (15) , PLL (110) (111) (11)
 2) , 1 (41) (51 101)

fr (111) (113) fo
 (11) (112) VCO(14) Fout fp

(11) fr fp 1 UP
 2 DN (41) (41) 1 2 UP, DN

Co LPF(13)

LPF(13) (41) Co Lo VCO(14)
 . VCO(14) Lo Fout Fout

(112)

Fout 가 , fp 가 fr
 fr, fp 가 (11) fr, fp 1 2
 UP, DN

(41) UP, DN Co LPF(13) , LPF(13)
 Co Lo Fout , Lo . VCO(14)
 Lo

1. Fout 가 , fp 가 fr
 2. fr, fp 가 (11) fr, fp 가 fr
 UP, DN .

Co (41) UP, DN Co LPF(13) , LPF(13)
 Fout . Lo . VCO(14) Lo

PLL (110) , VCO(14) Fout
 , PLL PLL (110) (41) ,

가 PLL

(57)

1.

1 , 2
 / ,

2.

1 , 2
 / ,

가 가

3.

1 , 2

/

4.

1 , 2

/

가 가

5.

1

, 2

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가

가

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6.

1

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7.

1
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6

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1

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가

2

1

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1

2

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8.

7

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1 , 1 1
 ,
 1 , 2 2
 , 1 2 2 1

9.

7 , ,
 1 , 1 1
 ,
 1 , 2 2
 1 2 , ,
 , 2 1

10.

1 6 , , 1 1
 , 2 , , 1
 , 2 2 1 ,
 2 .

11.

10 , 2 2 가 ,
 , 2 2
 .

12.

10 , ,
 1 , 1 1
 ,
 1 , 2 2
 , 1 2 , 2
 2 .

13.

10 , ,

1 , , 1 1

1 , , 2 2

1 2 , ,

2 2

14.

, 1 2 1 2

;

1 2 , 1 2

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/ , , 1 2

1 2 ,

1 1 1

3 ,

2 2 2

4 ,

3 PLL 3 , 1 2

15.

14 , PLL ,

PLL .

16.

14 , ; ,

(comparative frequency divider)

PLL .

17.

, 1 2 1 2

;

1 2 ; 1 2

;

,

,

/ , -- 가 , 1 2

-- ,

,

1 2

1 2

,

A/D ,

1 , 2

2 , 1

PLL .

18.

17 , 3 3 4

4 ;

3 4

4 , 3 PLL .

19.

17 , PLL .

20.

17 , ;

PLL .

21.

, 1 2 1 2 ;

1 2 ; , 1 2

/ , , 1 2 , 1 2 1 2 -- 1 2 1 2 -- , 1 2 1 2 3 2 , 1 가 , 3 1 , 1 2 3 1 , 2 1 , 3 2 , 2 , 2

3 , 4 ,

3 1 PLL . , 4 2

22.

21 , PLL .

23.

21 , ;

PLL .

24.

, 1 2 1 2 ;

1 2 ; , 1 2
 ;
 ,
 / , , , 1 2
 2 , 1 1 1
 , 1 1 2
 1 1 , 2 2
 , 1 1 ,
 1 1 , 3 2
 , 2
 1 1 , 1 2
 , PLL . 2 2

25.

24 , PLL .

26.

24 , ;

PLL .

27.

1 2 ; 1 2

1 2 ; , 1 2

, ,

/ , -- , 1 2
-- , 1

2 1 1 1 ,
2 3 1 2
1 1 , 2 2 ,

1 ,
2 ,

1 2 PLL

28.

27 , PLL .

29.

27 , ;

PLL , .

30.

, 1 2 1 2 ;

1 2 , 1 2 ;

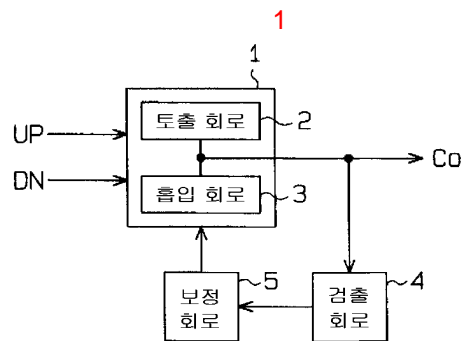
, ,

/ , -- , 1 2
-- , 1

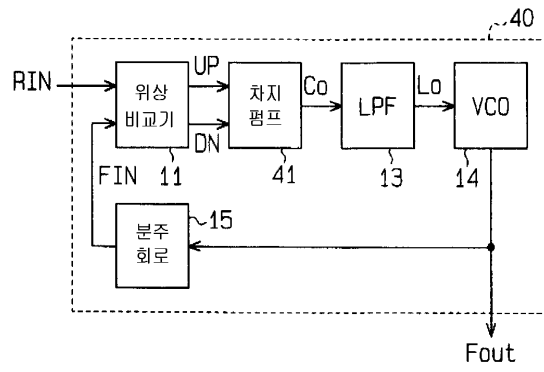
2 1 , 1

1 , 1 2
 , 2 1 1 1
 , 3 1 2 2
 1 1 , 2 2 ,
 1 , 2
 PLL , 2
 31.
 30 , PLL ,
 32.
 30 , ;

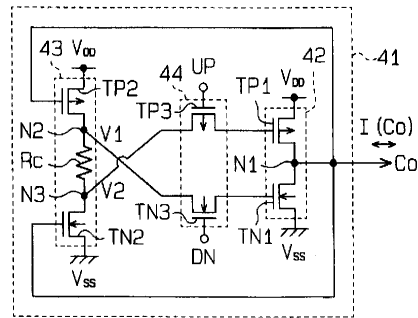
PLL .



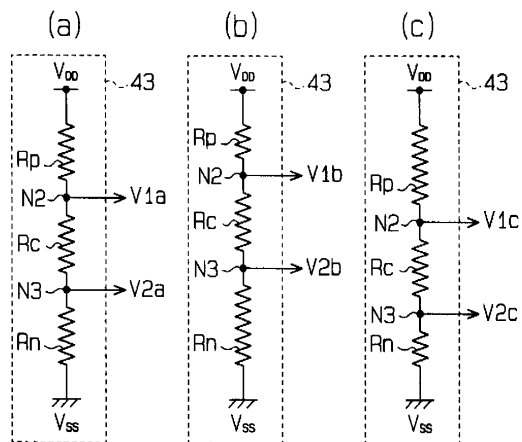
2



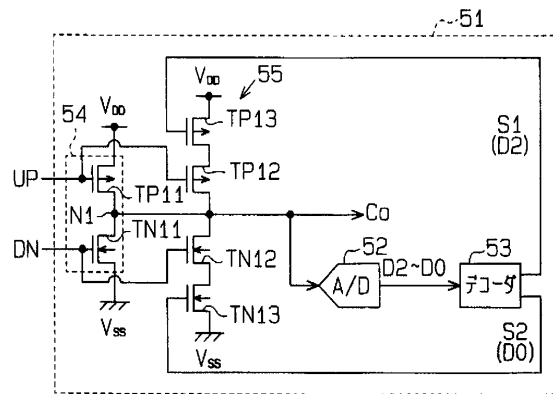
3



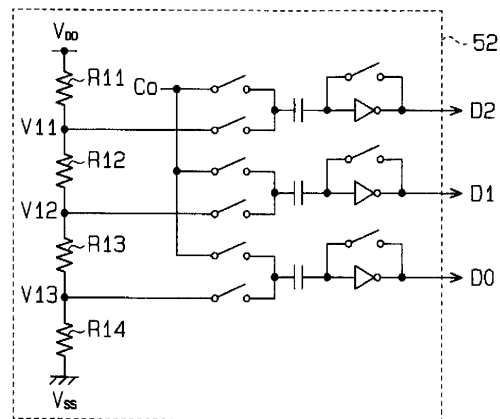
4



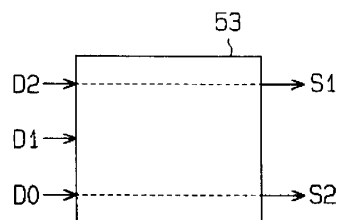
5



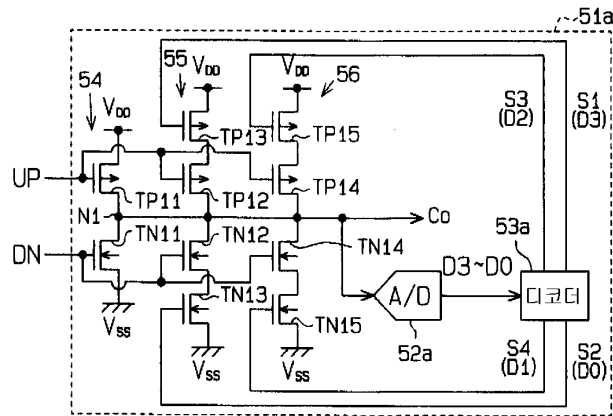
6



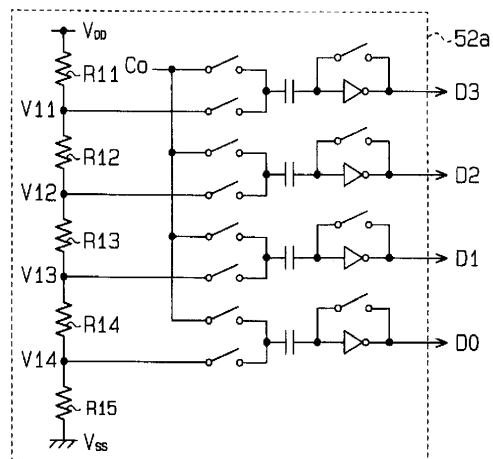
7



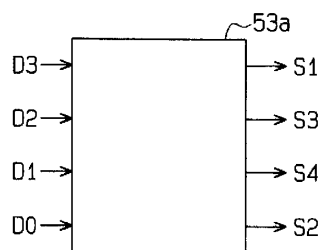
8



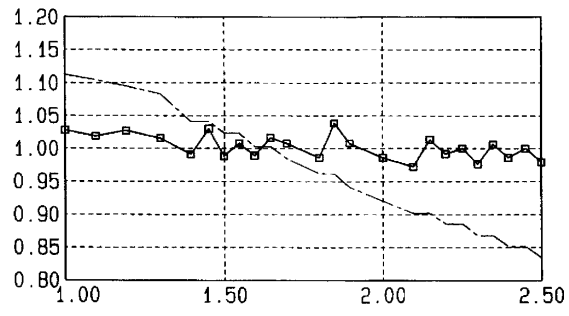
9



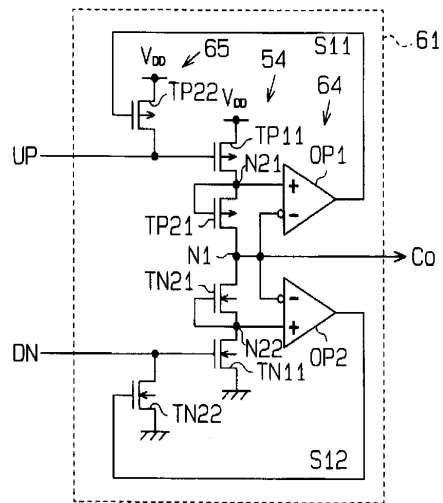
10



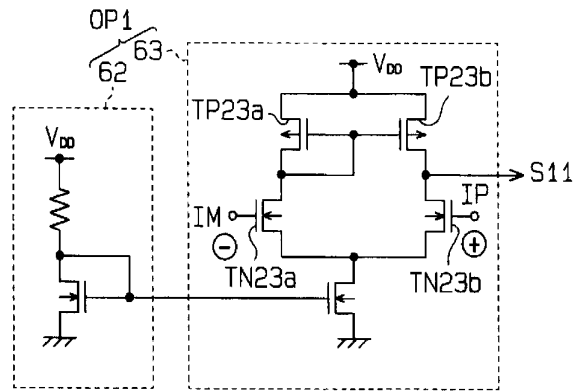
11



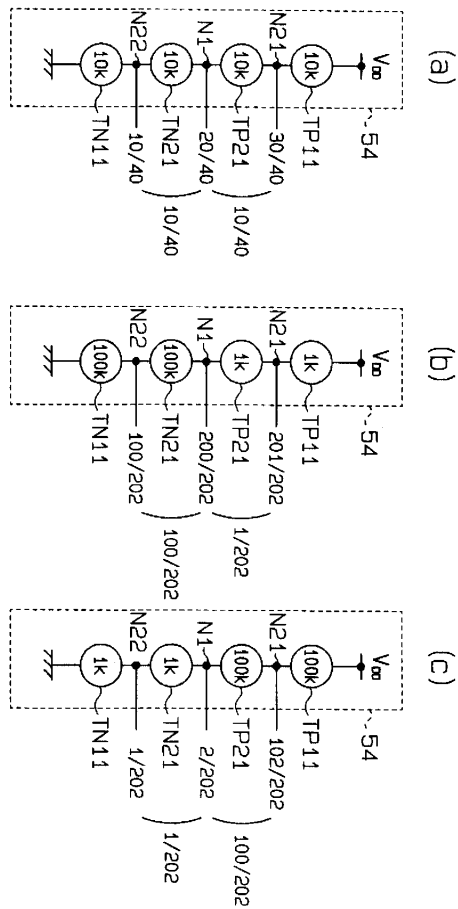
12



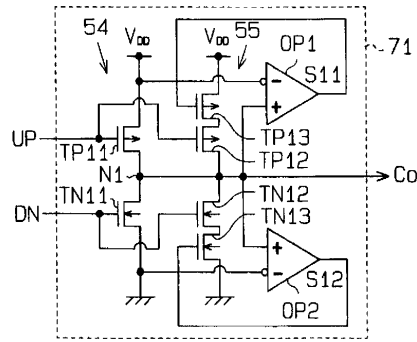
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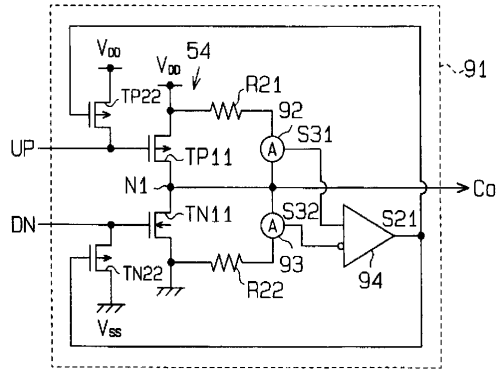
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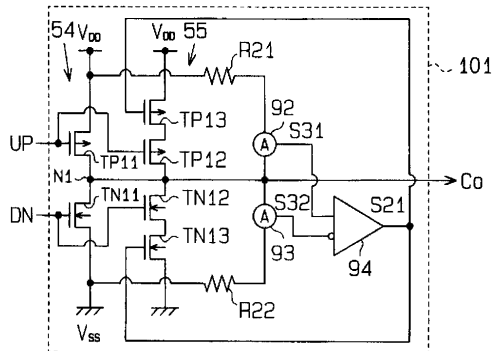
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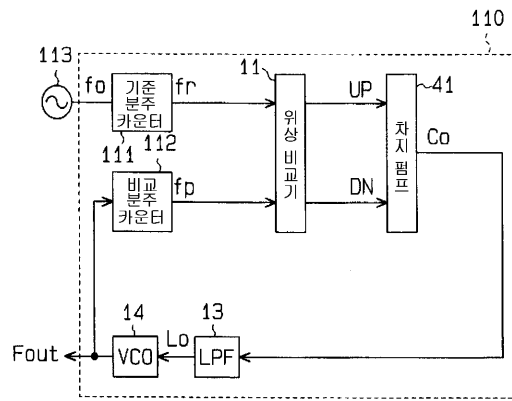
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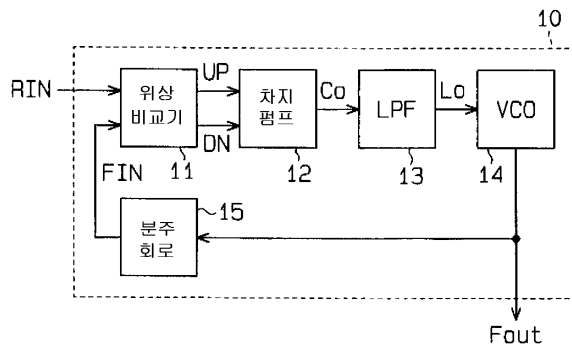
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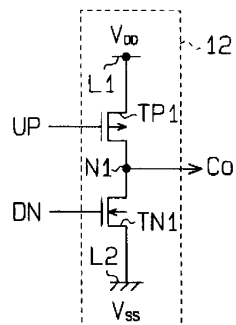
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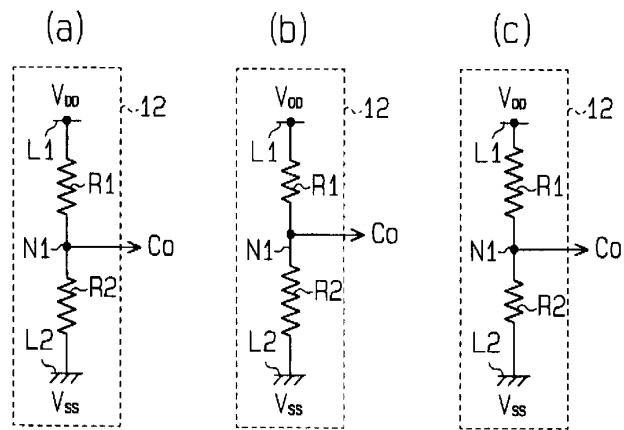
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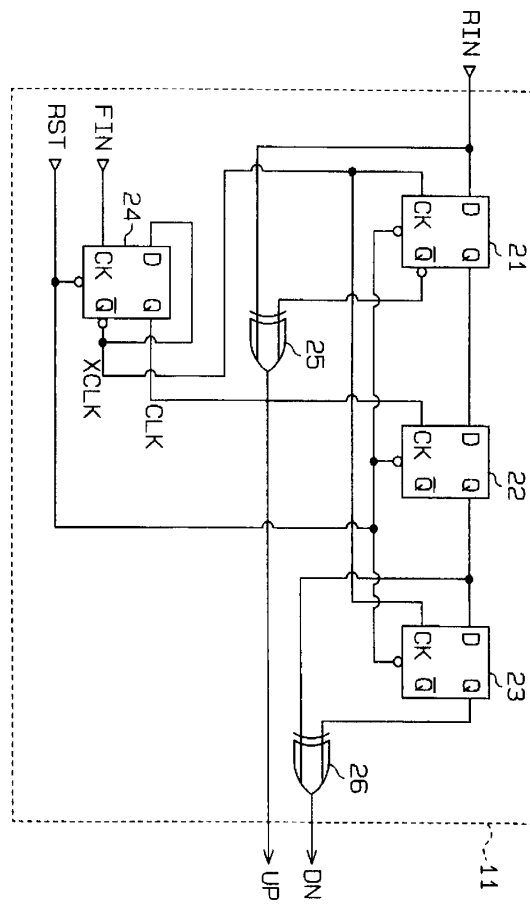
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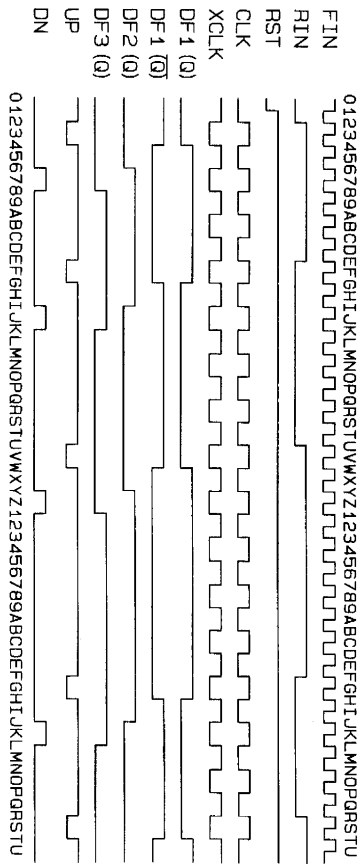
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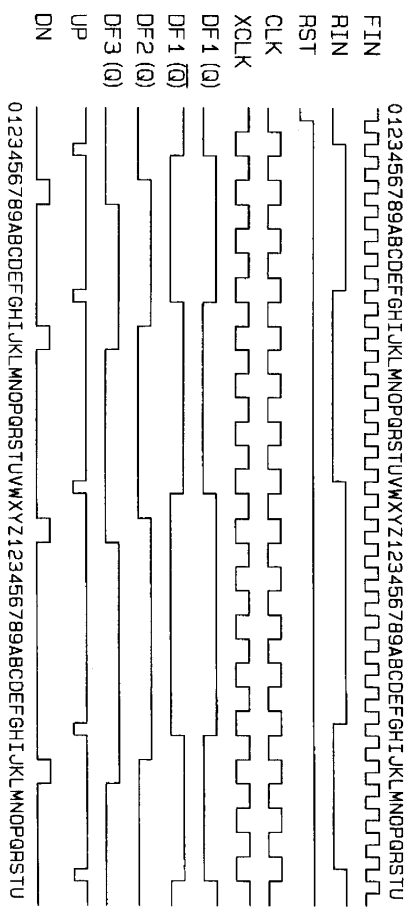


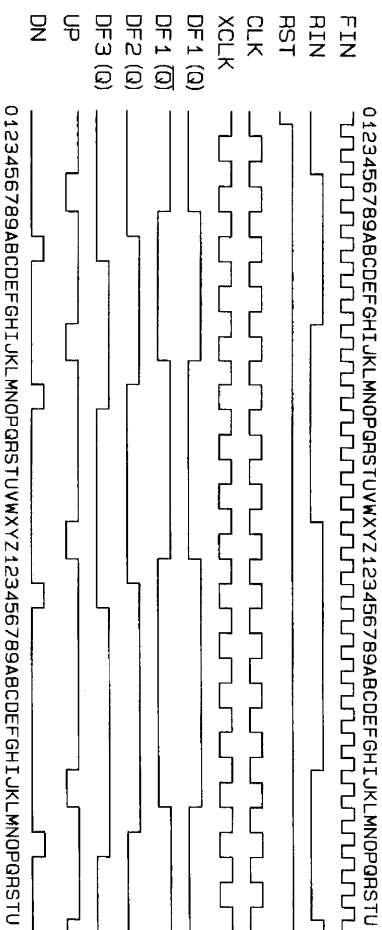
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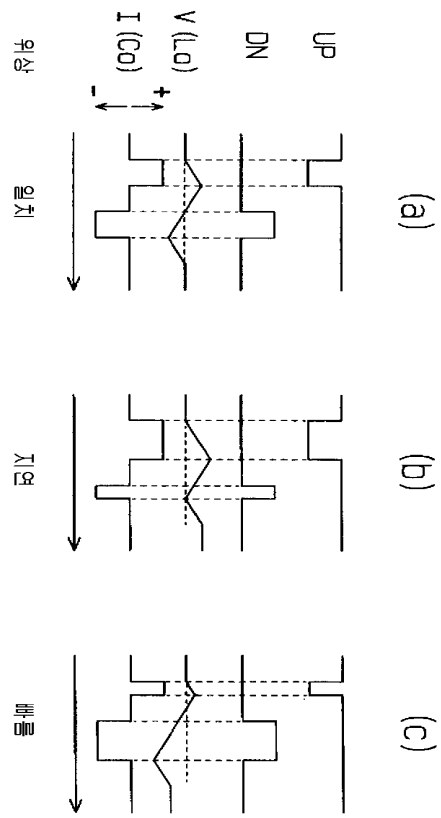


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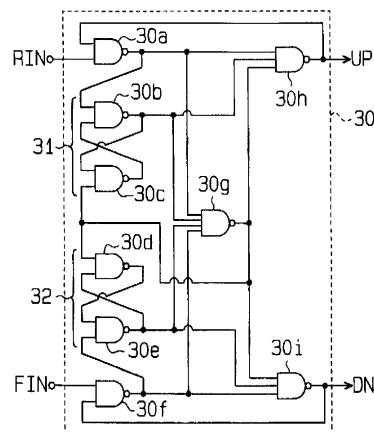




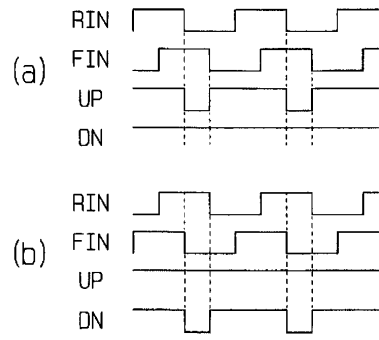
27

구분 구분명	V (N1)	
	지연	위상 일치
pch>nch		
pch=nch		
pch<nch		
	배율	
pch>nch		
pch=nch		
pch<nch		

28



29



30

V(N1)	구동신호		
	지연	위상 일치	비율
pch>nch			
pch=nch			
pch<nch			