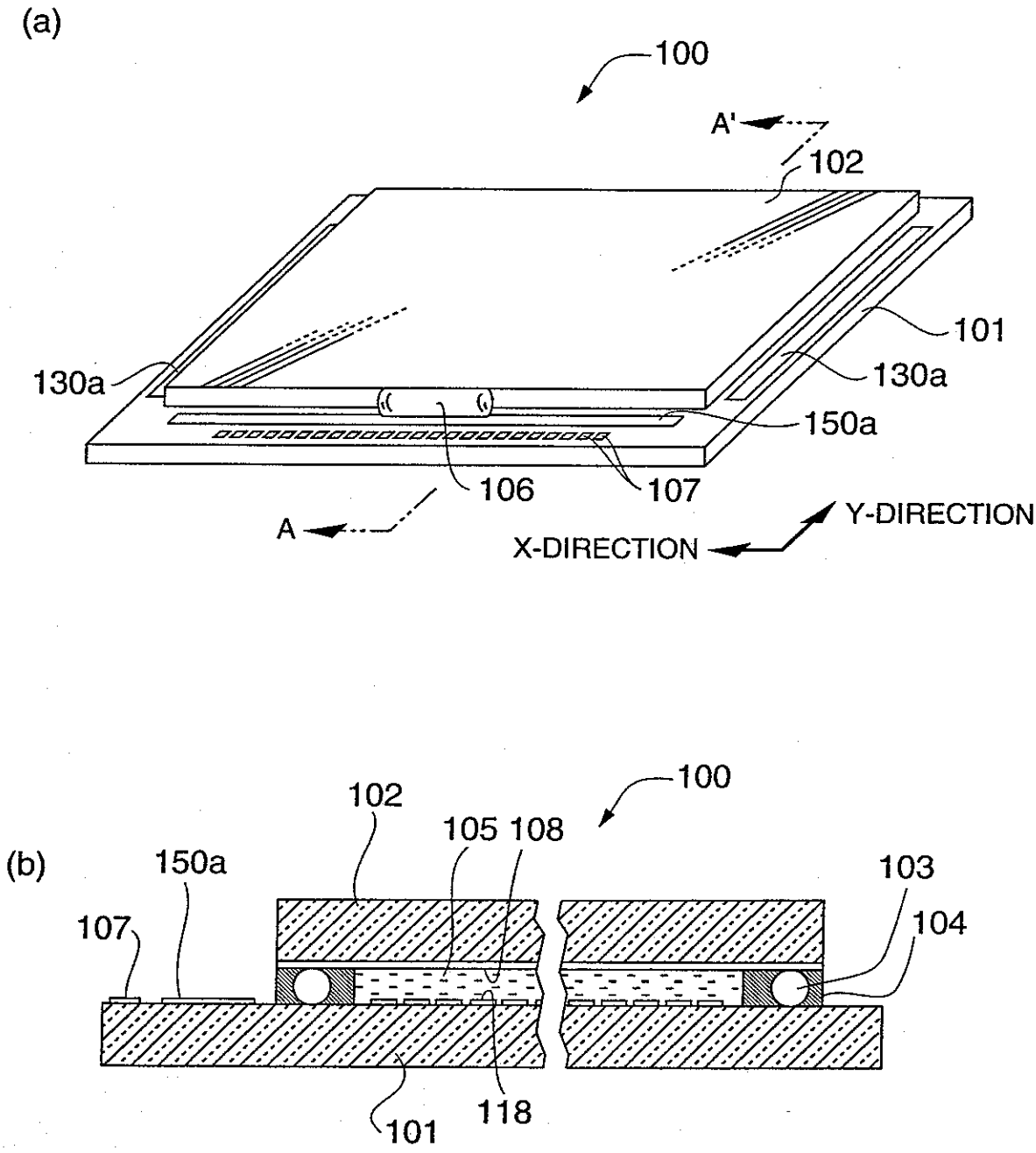

(a)
100
A'
102
101
130a
130a
150a
106
107
A
Y-DIRECTION
X-DIRECTION
(b)
100
102
105 108
150a
103
107
104
101
118

FIG. 1

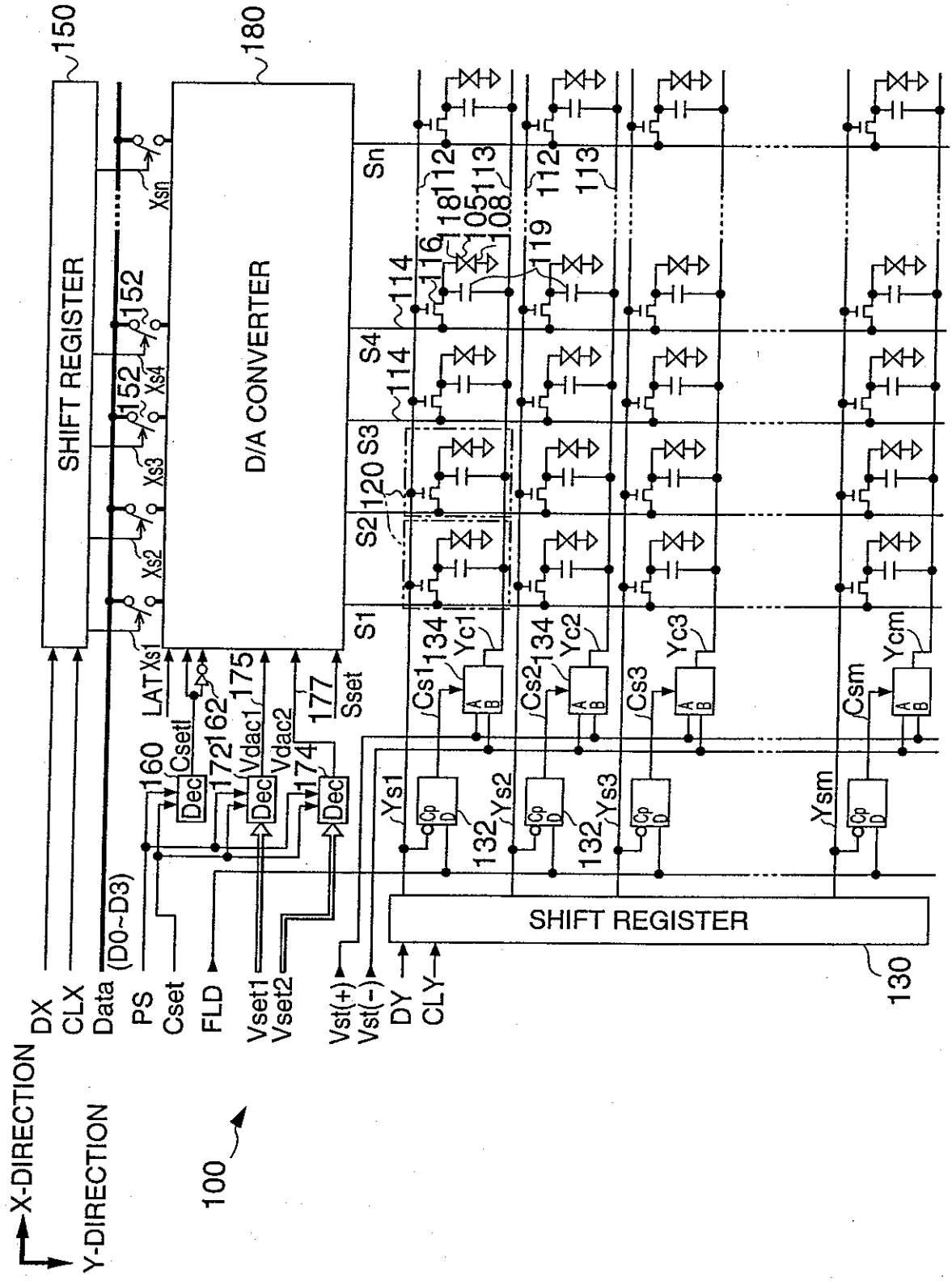

SHIFT REGISTER
150
D/A CONVERTER
180
Xsn
Xs4
Xs3
Xs2
Xs1
152
LAT
Cset
Vdac1
Vdac2
Sset
160
162
172
174
175
177
Dec
Sn
S4
S3
S2
S1
112
113
114
116
118
119
105
108
120
134
Cs1
Cs2
Cs3
Csm
Yc1
Yc2
Yc3
Ycm
Ys1
Ys2
Ys3
Ysm
132
SHIFT REGISTER
130
DX
CLX
Data (D0~D3)
PS
Cset
FLD
Vset1
Vset2
Vst(+)
Vst(-)
DY
CLY
X-DIRECTION
Y-DIRECTION
100

FIG. 2

(a)

Csetl

		Cset	
		L	H
PS	L	L	H
	H	H	L

(b)

/ Csetl

		Cset	
		L	H
PS	L	H	L
	H	L	H

FIG. 3

Vdac1

		Cset	
		L	H
PS	L	Vsk(-)	Vcw(-)
	H	Vsw(+)	Vck(+)

FIG. 4

Vdac2

		Cset	
		L	H
PS	L	Vsw(-)	Vck(-)
	H	Vsk(+)	Vcw(+)

FIG. 5

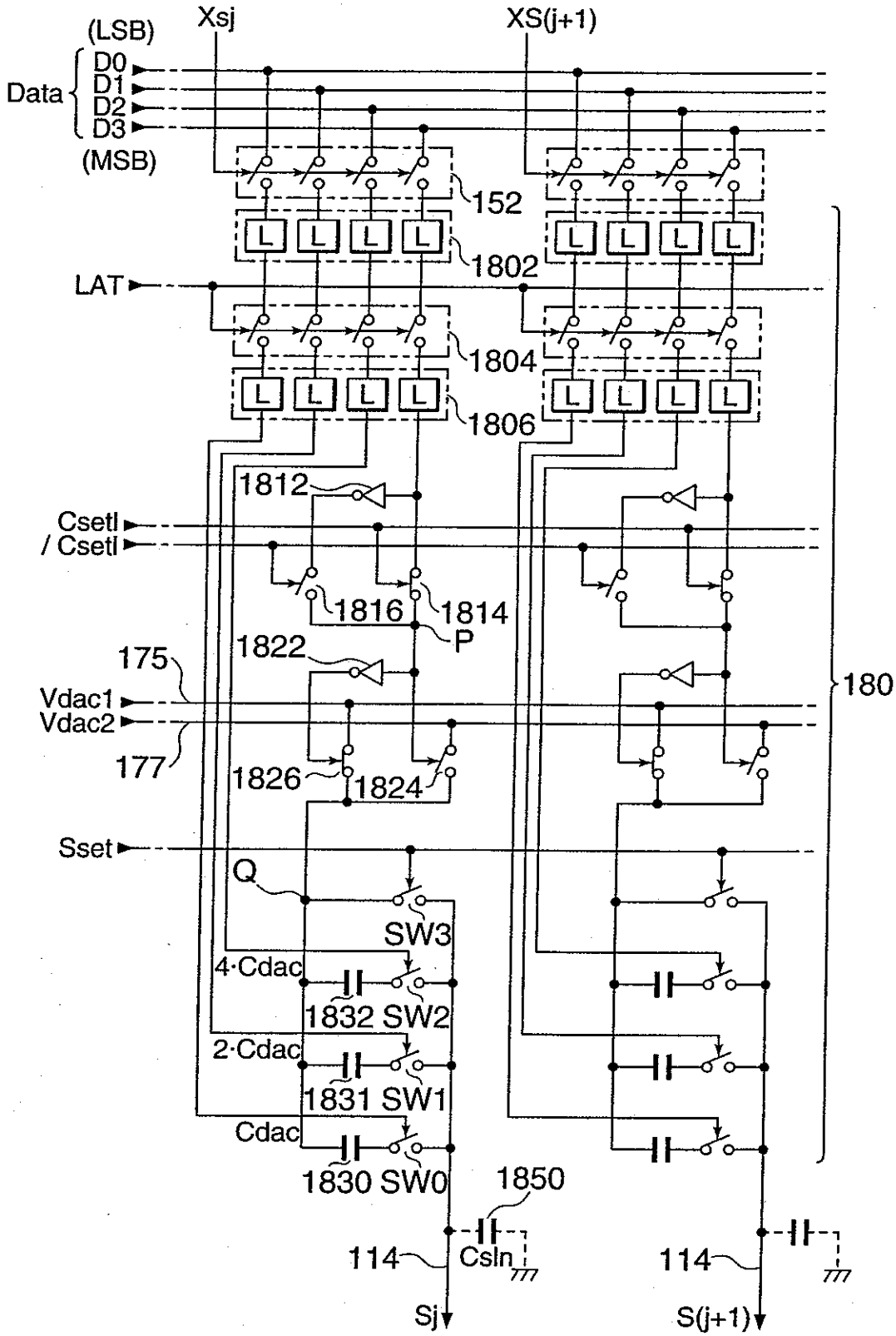

(LSB)
Data
D0
D1
D2
D3
(MSB)
Xsj
XS(j+1)
152
1802
LAT
1804
1806
1812
CsetI
/ CsetI
1816
1814
P
1822
175
Vdac1
Vdac2
177
1826
1824
Sset
Q
SW3
4·Cdac
1832 SW2
2·Cdac
1831 SW1
Cdac
1830 SW0
1850
114
CsIn
Sj
114
S(j+1)
180

FIG. 6

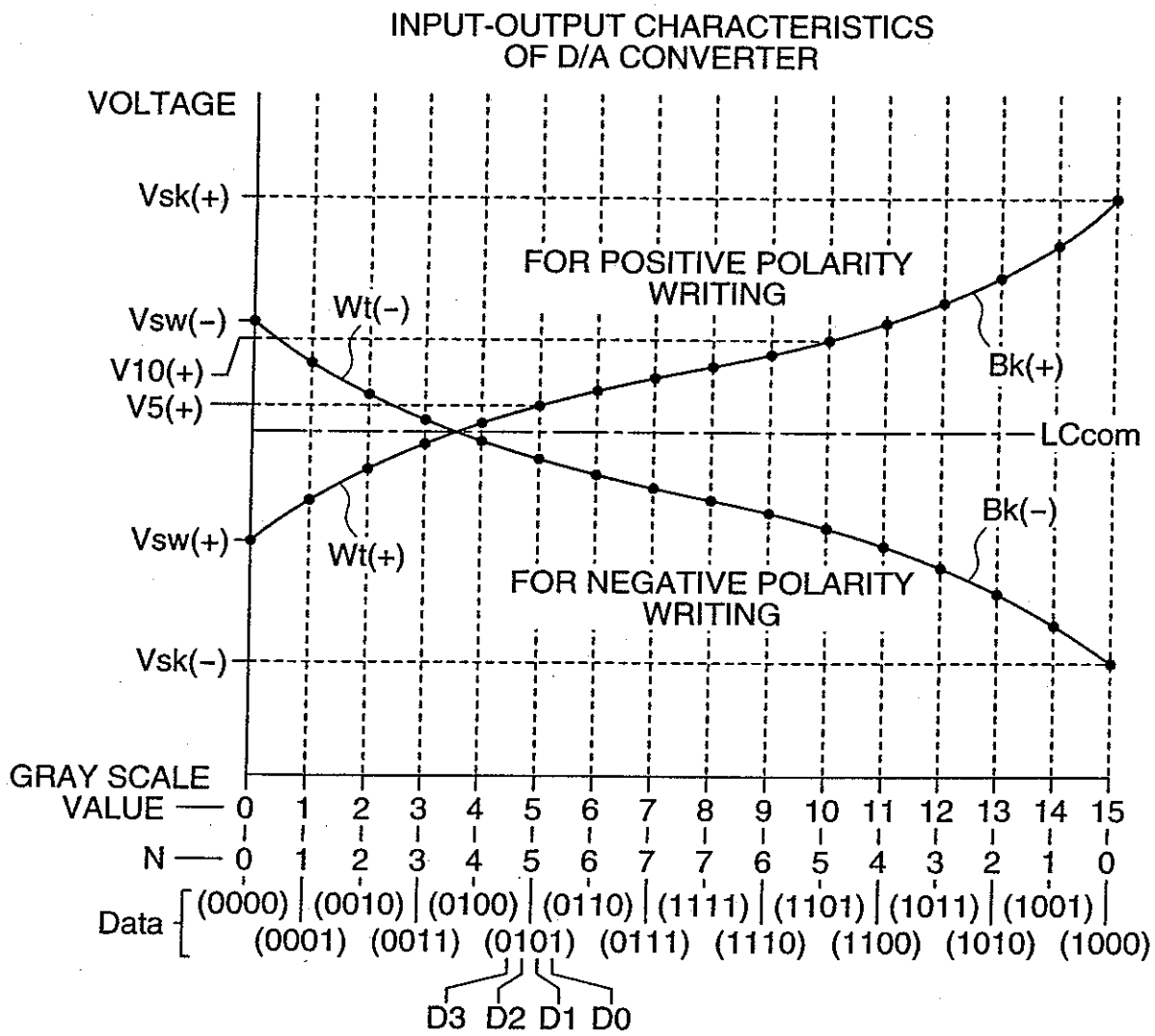

INPUT-OUTPUT CHARACTERISTICS
OF D/A CONVERTER
VOLTAGE
Vsk(+)
Vsw(−)
V10(+)
V5(+)
Vsw(+)
Vsk(−)
Wt(−)
Wt(+)
FOR POSITIVE POLARITY
WRITING
FOR NEGATIVE POLARITY
WRITING
Bk(+)
Bk(−)
LCcom
GRAY SCALE
VALUE
N
Data
(0000) (0001) (0010) (0011) (0100) (0101) (0110) (0111) (1111) (1110) (1101) (1100) (1011) (1010) (1001) (1000)
D3 D2 D1 D0

FIG. 7

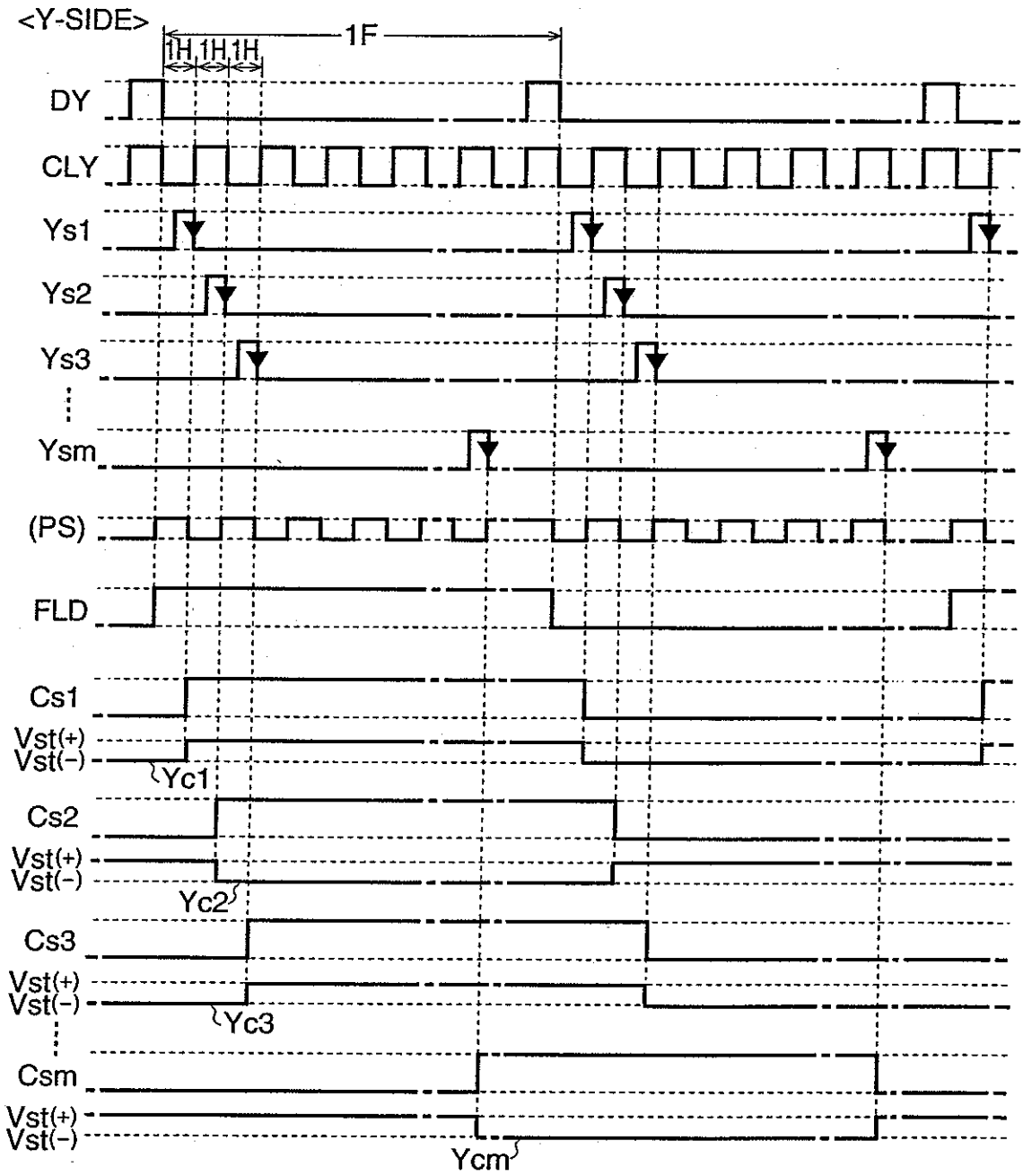

<Y-SIDE>
1H
1H
1H
1F
DY
CLY
Ys1
Ys2
Ys3
Ysm
(PS)
FLD
Cs1
Vst(+)
Vst(-)
Yc1
Cs2
Vst(+)
Vst(-)
Yc2
Cs3
Vst(+)
Vst(-)
Yc3
Csm
Vst(+)
Vst(-)
Ycm

FIG. 8

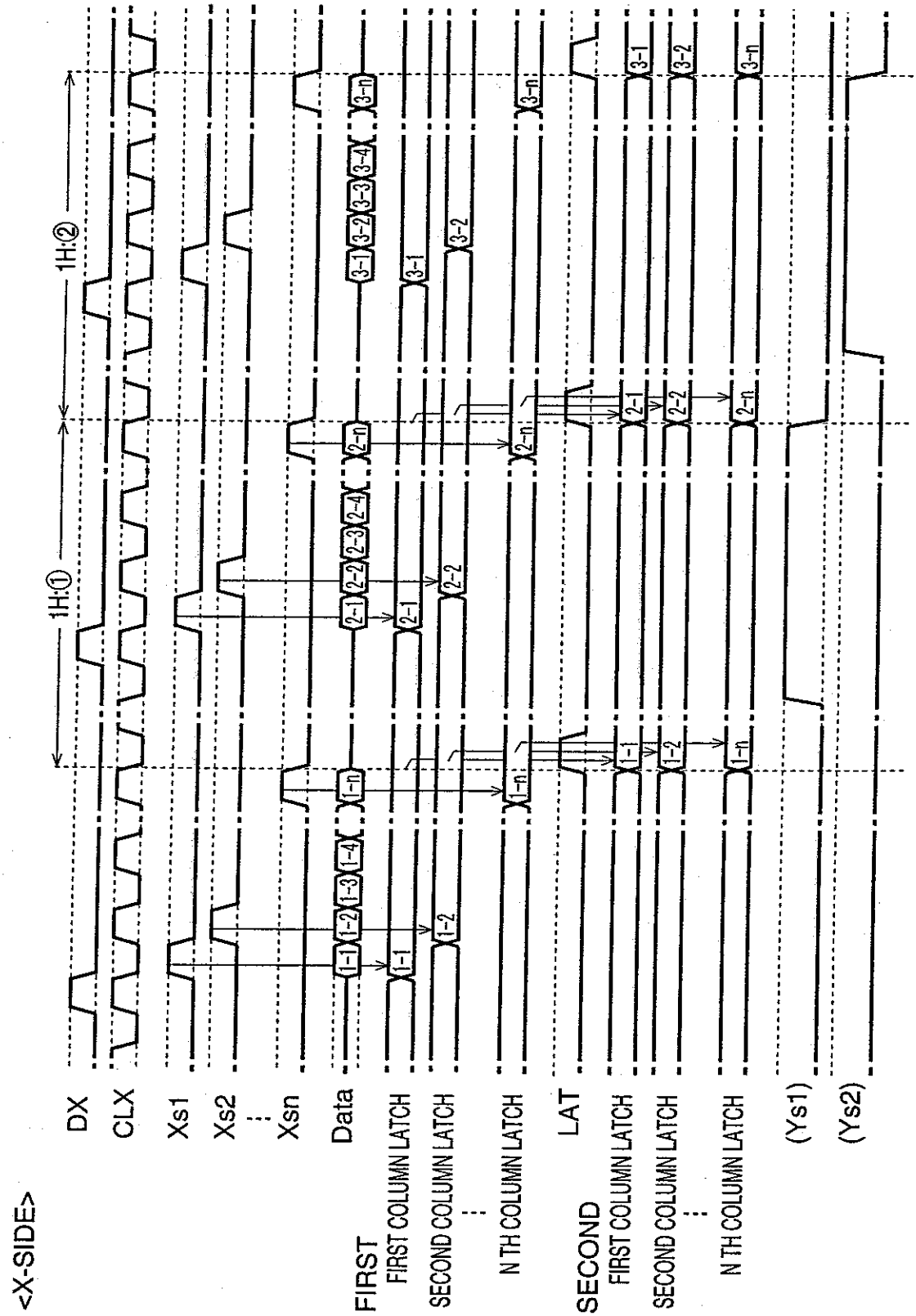

<X-SIDE>
DX
CLX
Xs1
Xs2
Xsn
Data
FIRST
FIRST COLUMN LATCH
SECOND COLUMN LATCH
N TH COLUMN LATCH
LAT
SECOND
FIRST COLUMN LATCH
SECOND COLUMN LATCH
N TH COLUMN LATCH
(Ys1)
(Ys2)
1H:①
1H:②

FIG. 9

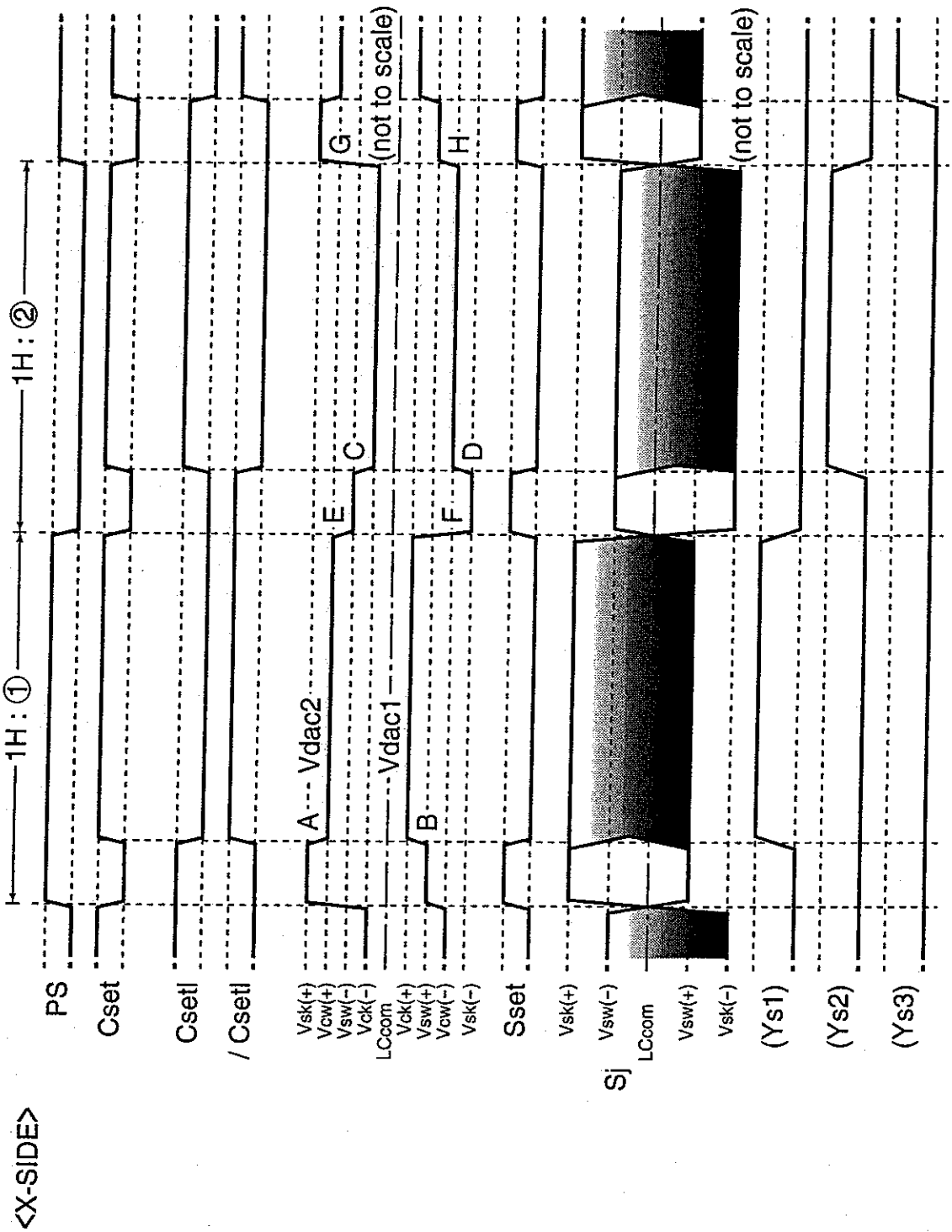

<X-SIDE>
1H : ①
1H : ②
PS
Cset
Csetl
/ Csetl
Vsk(+)
Vcw(+)
Vsw(−)
Vck(−)
LCcom
Vck(+)
Vsw(+)
Vcw(−)
Vsk(−)
Sset
Vsk(+)
Vsw(−)
Sj
LCcom
Vsw(+)
Vsk(−)
A
B
C
D
E
F
G
H
Vdac2
Vdac1
(not to scale)
(not to scale)
(Ys1)
(Ys2)
(Ys3)

FIG. 10

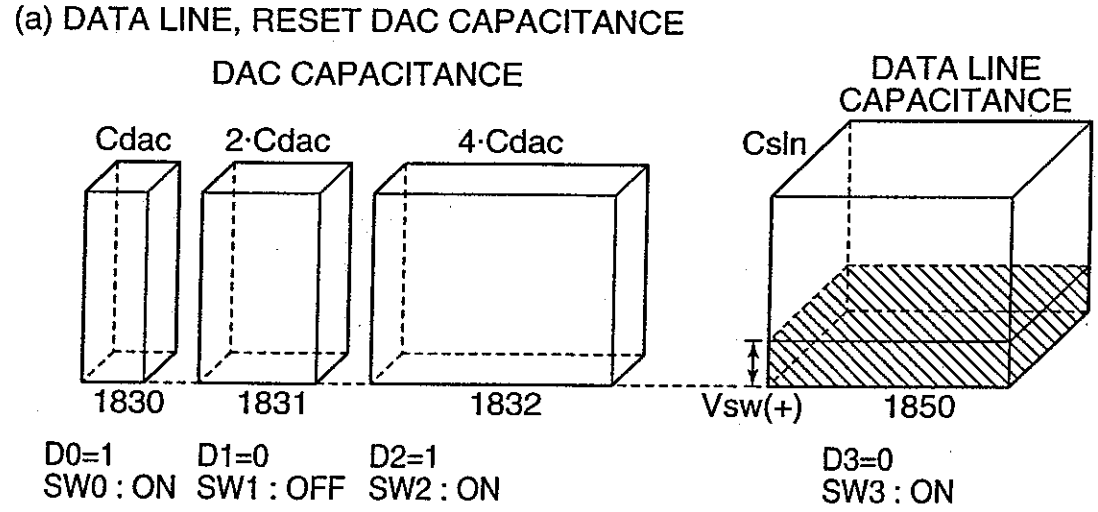

(a) DATA LINE, RESET DAC CAPACITANCE
DAC CAPACITANCE
DATA LINE CAPACITANCE
Cdac
2·Cdac
4·Cdac
Csln
1830
1831
1832
Vsw(+)
1850
D0=1
SW0 : ON
D1=0
SW1 : OFF
D2=1
SW2 : ON
D3=0
SW3 : ON
(b) DAC CAPACITANCE WRITING
Vcw(+)
Vsw(+)
SW0 : ON
SW1 : OFF
SW2 : ON
SW3 : OFF
(C) CHARGE DISTRIBUTION
V5(+)

FIG. 11

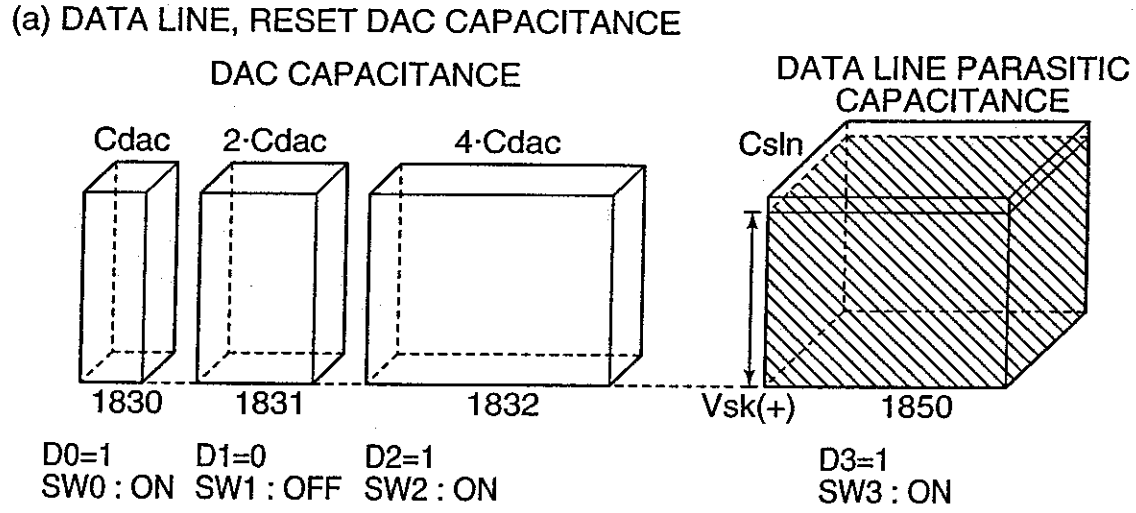
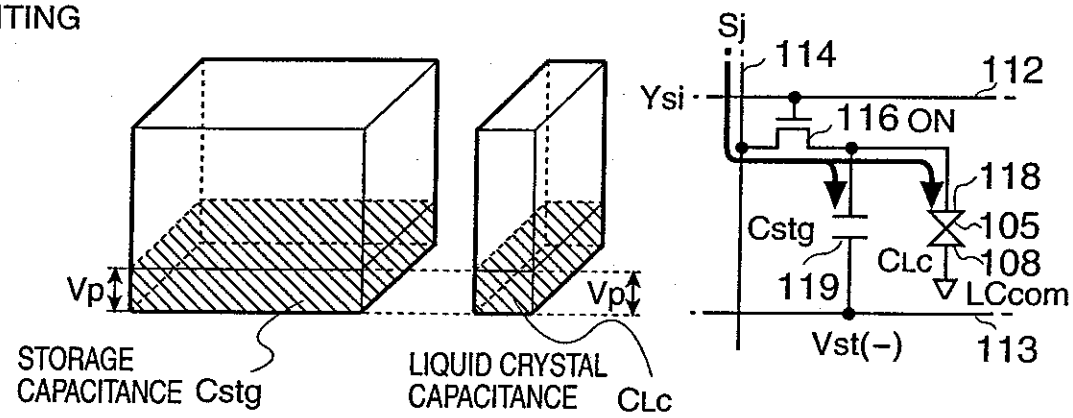
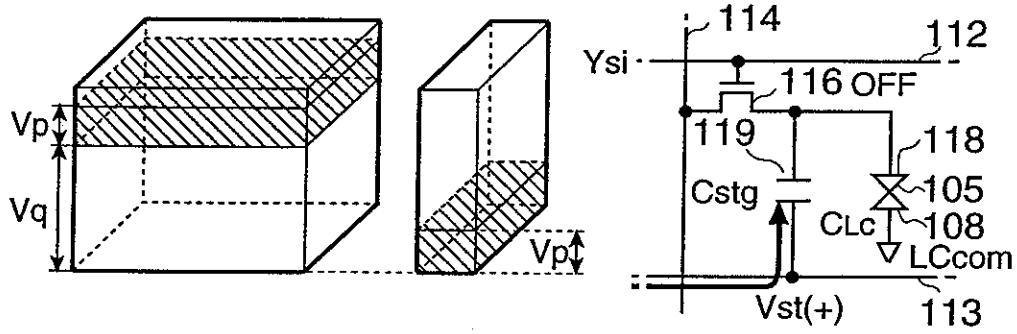

(a) DATA LINE, RESET DAC CAPACITANCE
DAC CAPACITANCE
DATA LINE PARASITIC CAPACITANCE
Cdac
2·Cdac
4·Cdac
Csln
1830
1831
1832
Vsk(+)
1850
D0=1
SW0 : ON
D1=0
SW1 : OFF
D2=1
SW2 : ON
D3=1
SW3 : ON
(b) SW0 OFF, DAC CAPACITANCE WRITING
Vck(+)
Vsk(+)
SW0 : ON
SW1 : OFF
SW2 : ON
SW3 : OFF
(C) CHARGE DISTRIBUTION
V10(+)

FIG. 12

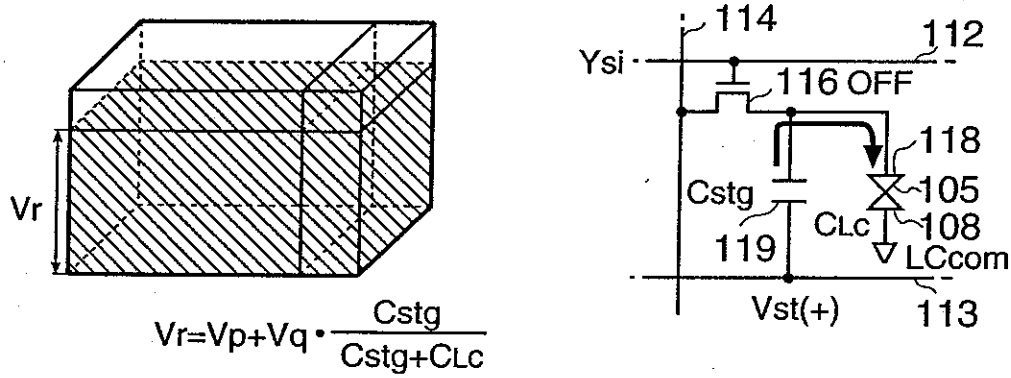
(a) WRITING



(b) VOLTAGE SHIFT OF STORAGE CAPACITANCE



(c) CHARGE REDISTRIBUTION



$$Vr=Vp+Vq\cdot\frac{Cstg}{Cstg+CLc}$$

FIG. 13

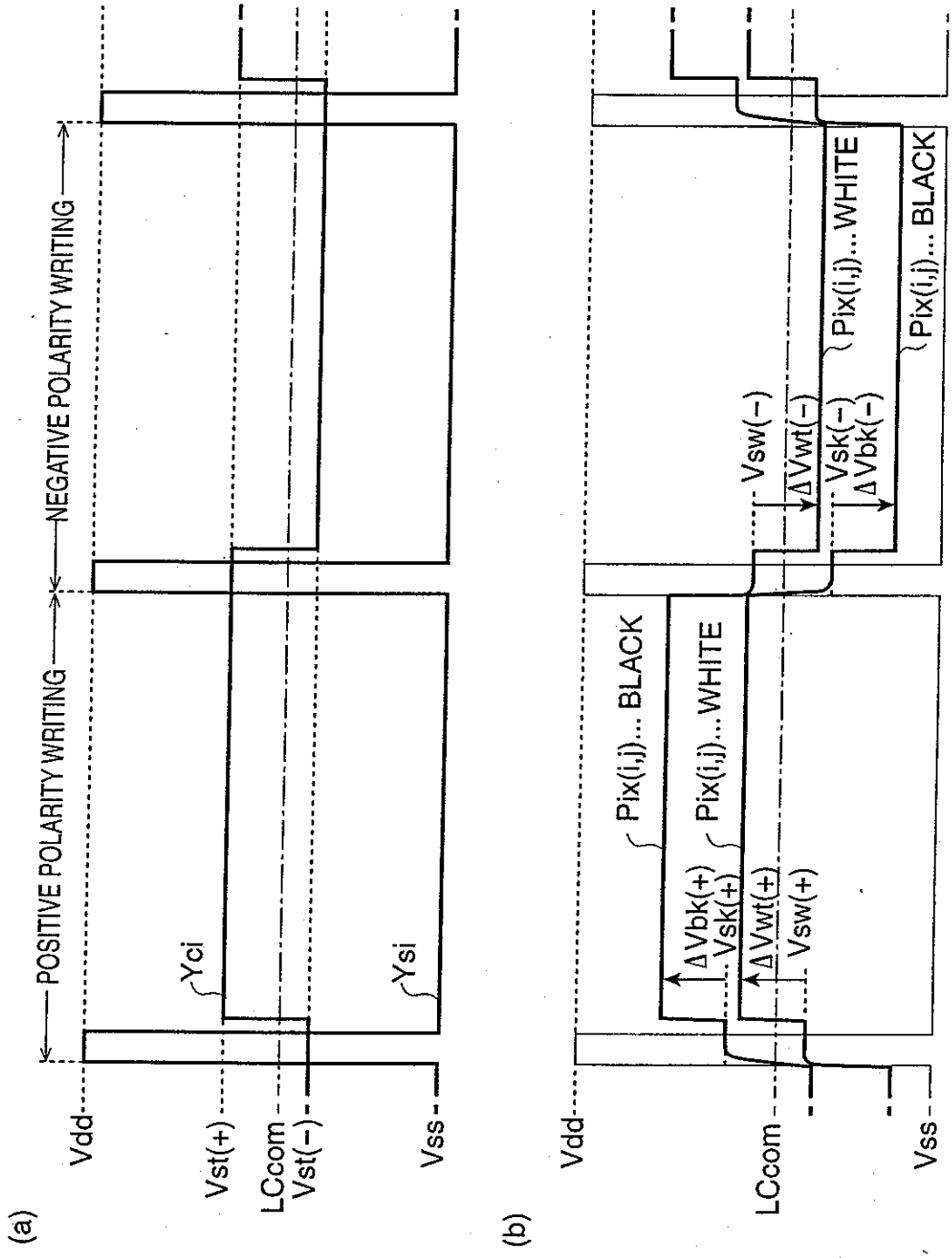

(a)
POSITIVE POLARITY WRITING
NEGATIVE POLARITY WRITING
Vdd
Vst(+)
LCcom
Vst(−)
Vss
Yci
Ysi
(b)
Vdd
LCcom
Vss
Pix(i,j)... BLACK
Pix(i,j)... WHITE
Pix(i,j)... WHITE
Pix(i,j)... BLACK
ΔVbk(+)
Vsk(+)
ΔVwt(+)
Vsw(+)
Vsw(−)
ΔVwt(−)
Vsk(−)
ΔVbk(−)

FIG. 14

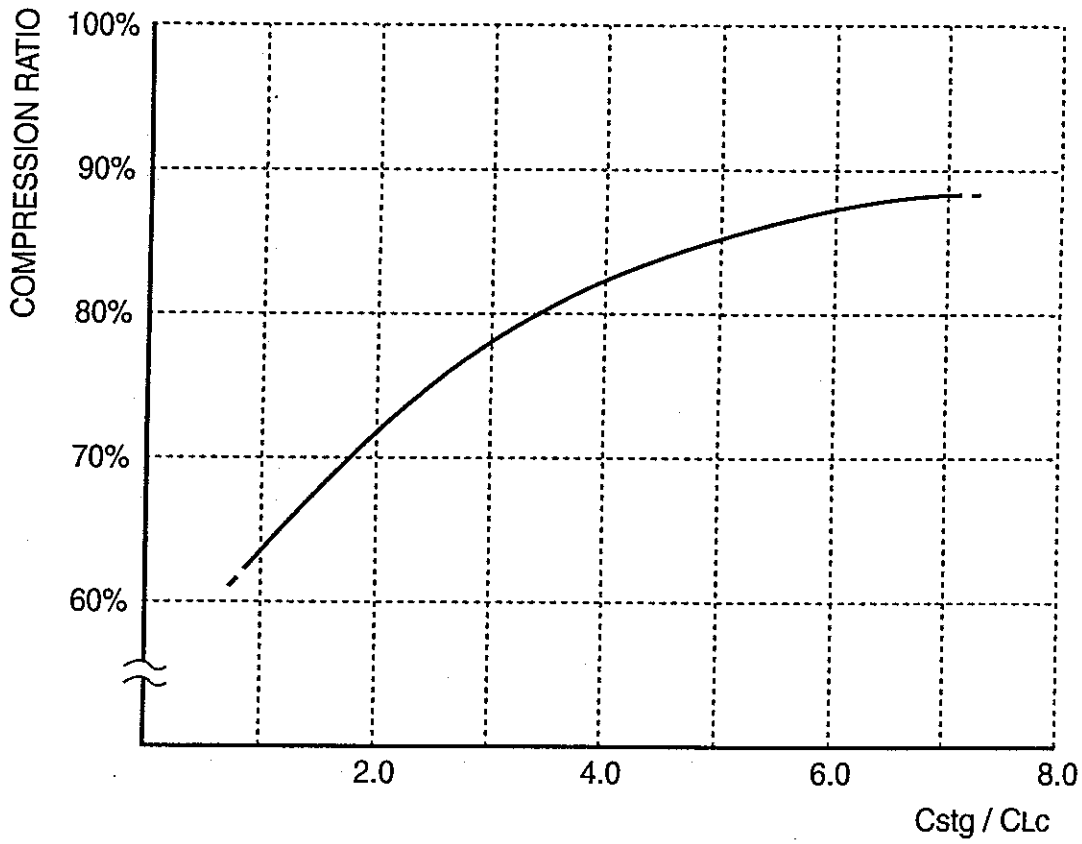


FIG. 15

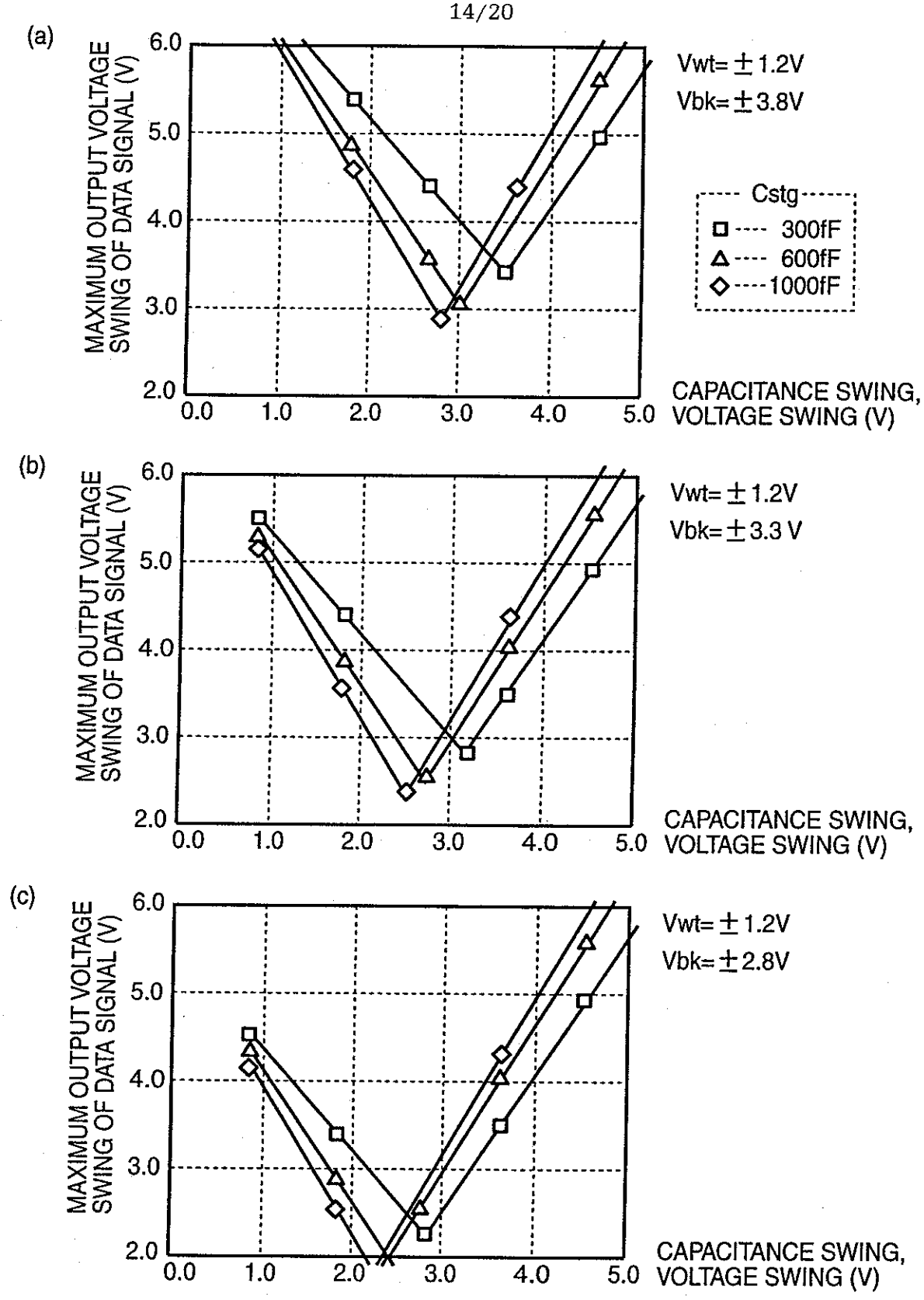

(a)
MAXIMUM OUTPUT VOLTAGE SWING OF DATA SIGNAL (V)
6.0
5.0
4.0
3.0
2.0
0.0
1.0
2.0
3.0
4.0
5.0
CAPACITANCE SWING, VOLTAGE SWING (V)
Vwt=±1.2V
Vbk=±3.8V
Cstg
300fF
600fF
1000fF
(b)
MAXIMUM OUTPUT VOLTAGE SWING OF DATA SIGNAL (V)
CAPACITANCE SWING, VOLTAGE SWING (V)
Vwt=±1.2V
Vbk=±3.3 V
(c)
MAXIMUM OUTPUT VOLTAGE SWING OF DATA SIGNAL (V)
CAPACITANCE SWING, VOLTAGE SWING (V)
Vwt=±1.2V
Vbk=±2.8V

FIG. 16

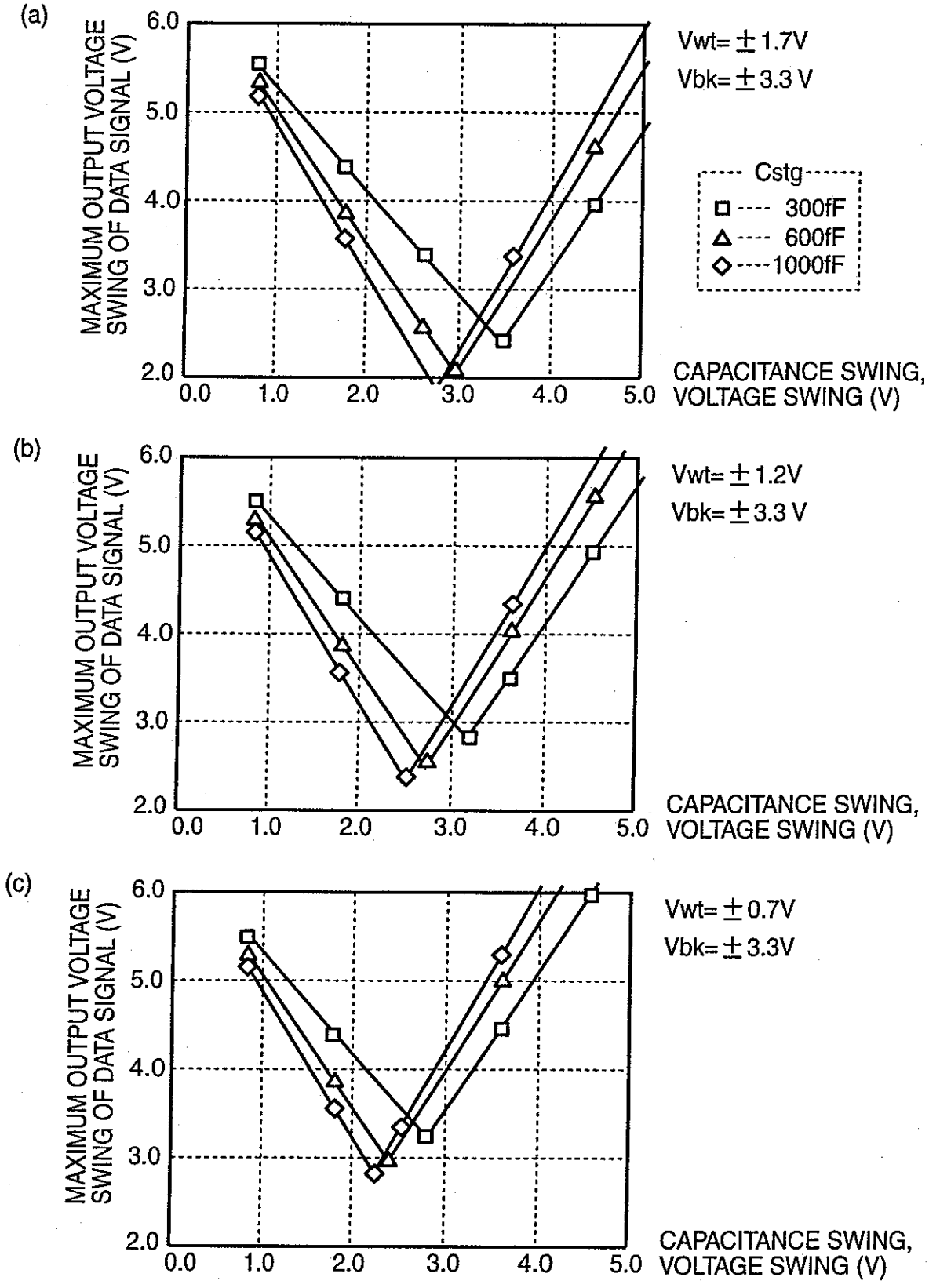

(a)
MAXIMUM OUTPUT VOLTAGE SWING OF DATA SIGNAL (V)
6.0
5.0
4.0
3.0
2.0
0.0
1.0
2.0
3.0
4.0
5.0
CAPACITANCE SWING, VOLTAGE SWING (V)
Vwt=±1.7V
Vbk=±3.3 V
Cstg
300fF
600fF
1000fF
(b)
MAXIMUM OUTPUT VOLTAGE SWING OF DATA SIGNAL (V)
CAPACITANCE SWING, VOLTAGE SWING (V)
Vwt=±1.2V
Vbk=±3.3 V
(c)
MAXIMUM OUTPUT VOLTAGE SWING OF DATA SIGNAL (V)
CAPACITANCE SWING, VOLTAGE SWING (V)
Vwt=±0.7V
Vbk=±3.3V

FIG. 17

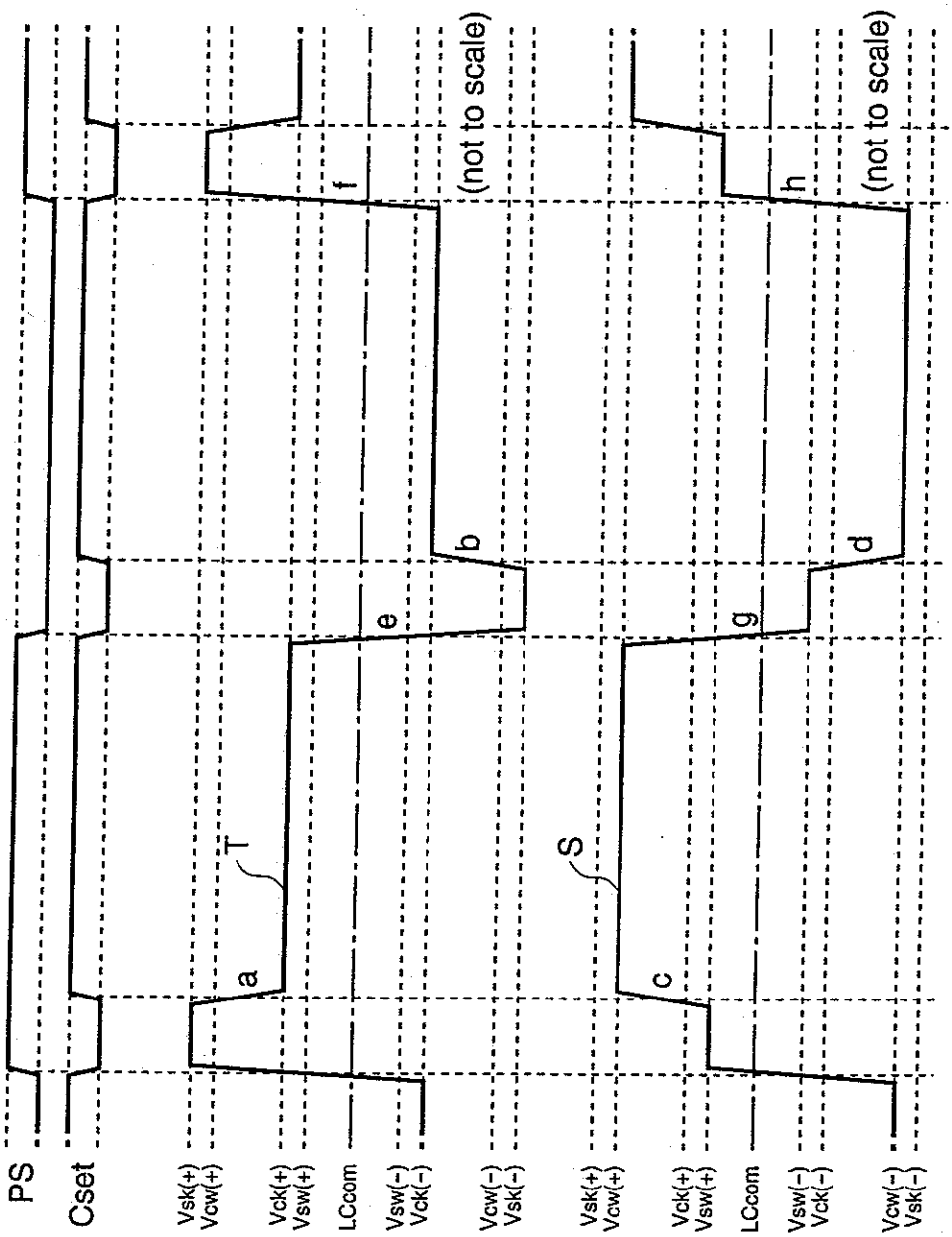

PS
Cset
Vsk(+)
Vcw(+)
Vck(+)
Vsw(+)
LCcom
Vsw(−)
Vck(−)
Vcw(−)
Vsk(−)
Vsk(+)
Vcw(+)
Vck(+)
Vsw(+)
LCcom
Vsw(−)
Vck(−)
Vcw(−)
Vsk(−)
T
S
a
b
c
d
e
f
g
h
(not to scale)
(not to scale)

FIG. 18

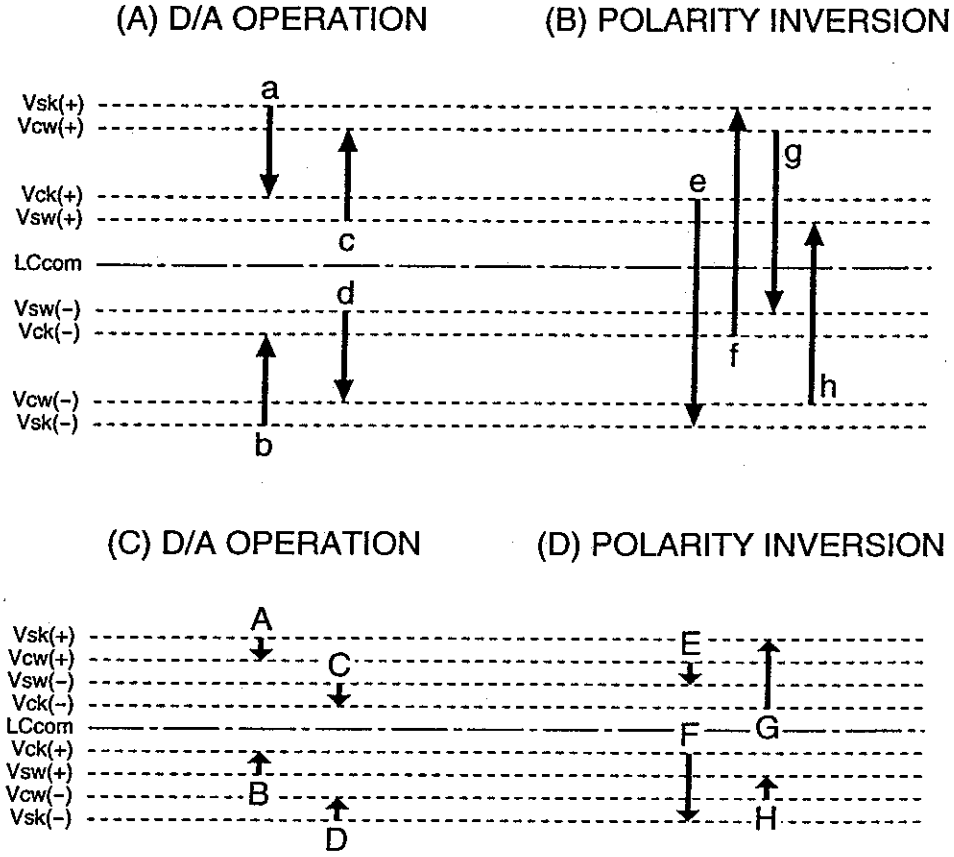

(A) D/A OPERATION
(B) POLARITY INVERSION
Vsk(+)
Vcw(+)
Vck(+)
Vsw(+)
LCcom
Vsw(−)
Vck(−)
Vcw(−)
Vsk(−)
a
b
c
d
e
f
g
h
(C) D/A OPERATION
(D) POLARITY INVERSION
Vsk(+)
Vcw(+)
Vsw(−)
Vck(−)
LCcom
Vck(+)
Vsw(+)
Vcw(−)
Vsk(−)
A
B
C
D
E
F
G
H

FIG. 19

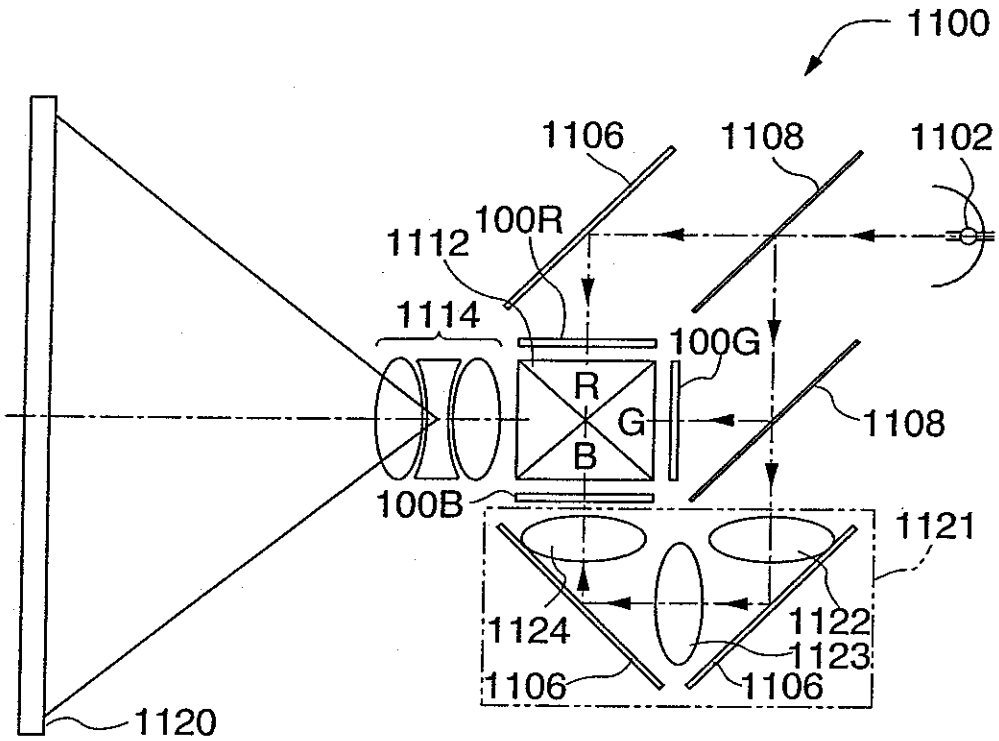

1100
1106
1108
1102
1112
100R
1114
100G
R
G
B
1108
100B
1121
1124
1122
1123
1106
1106
1120

FIG. 20

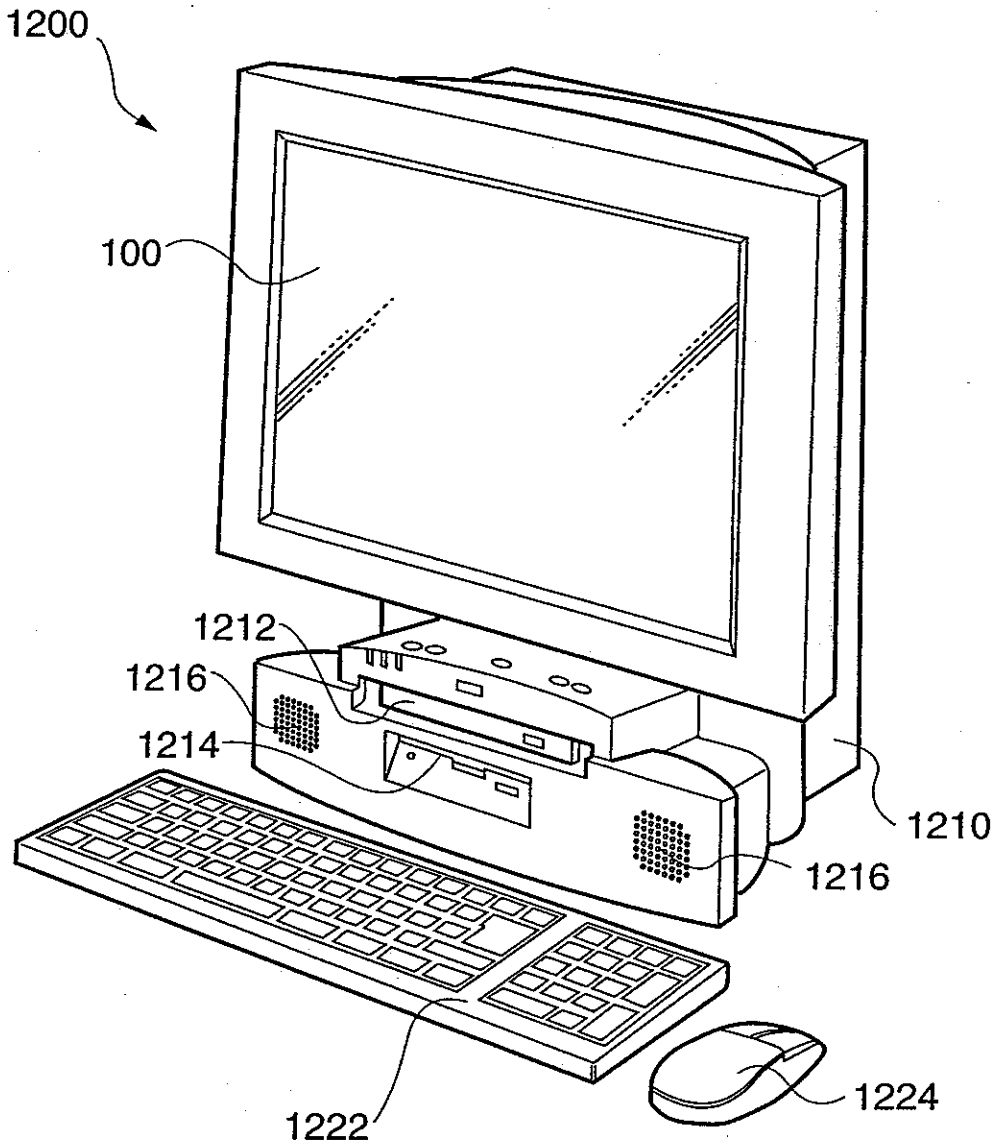


FIG. 21

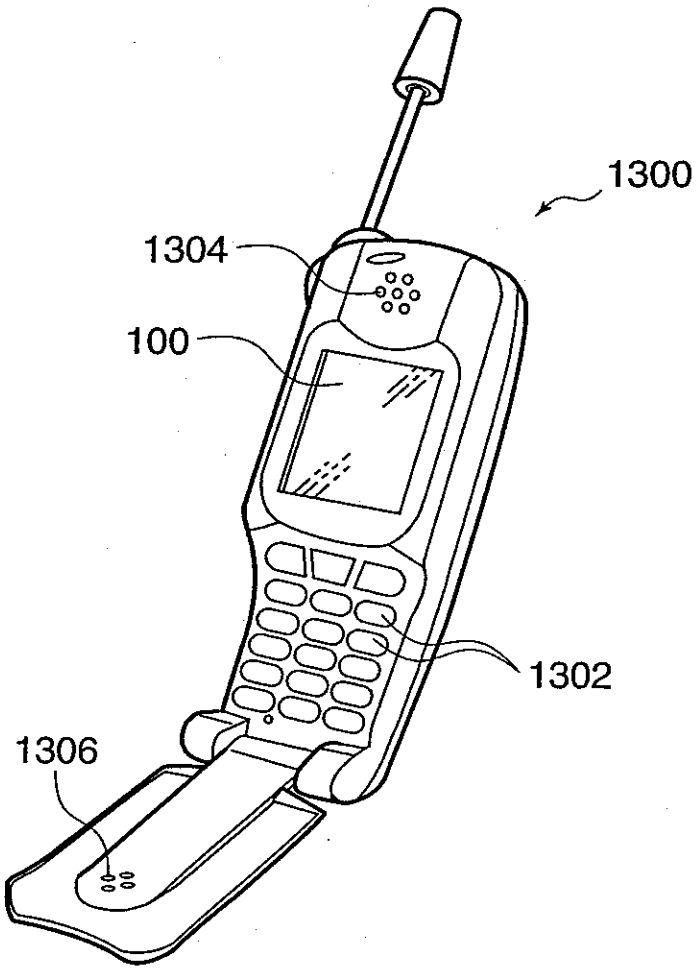


FIG. 22