FIG. 1

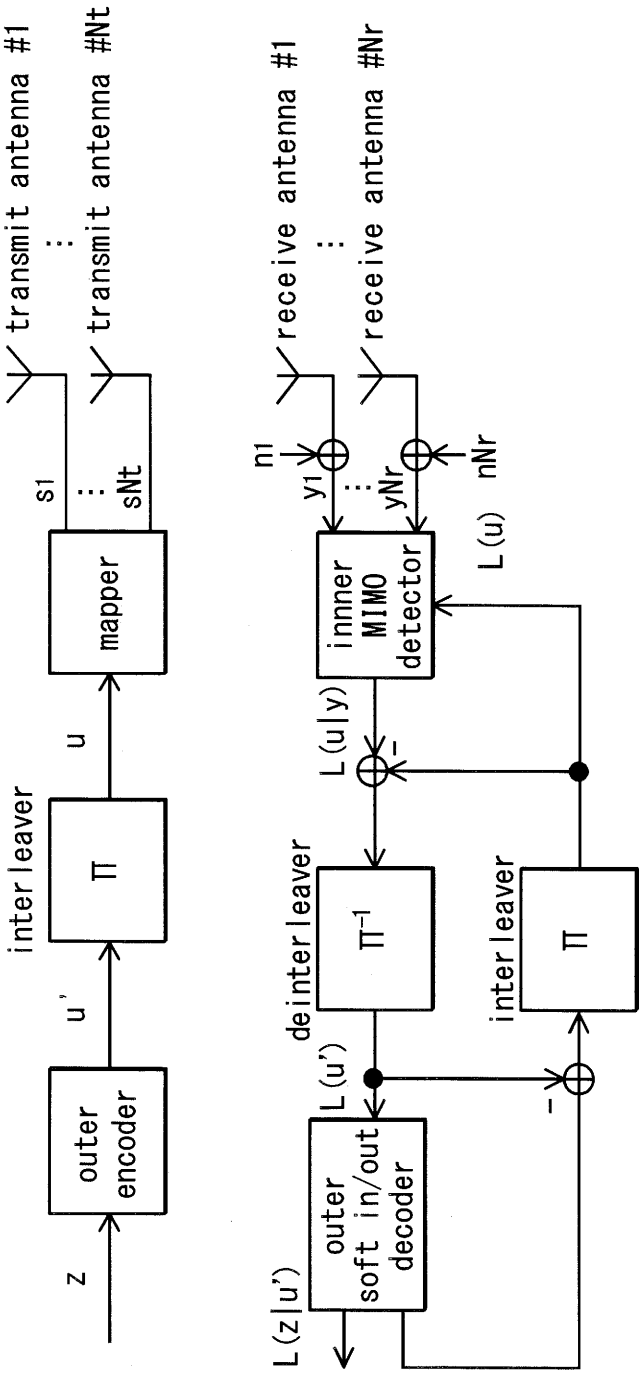

transmit antenna #1
transmit antenna #Nt
receive antenna #1
receive antenna #Nr
mapper
s1
sNt
inter leaver
Π
u
u'
outer encoder
z
n1
nNr
y1
yNr
innner MIMO detector
L(u)
L(u|y)
deinter leaver
Π-1
L(u')
outer soft in/out decoder
L(z|u')
inter leaver
Π

FIG. 2

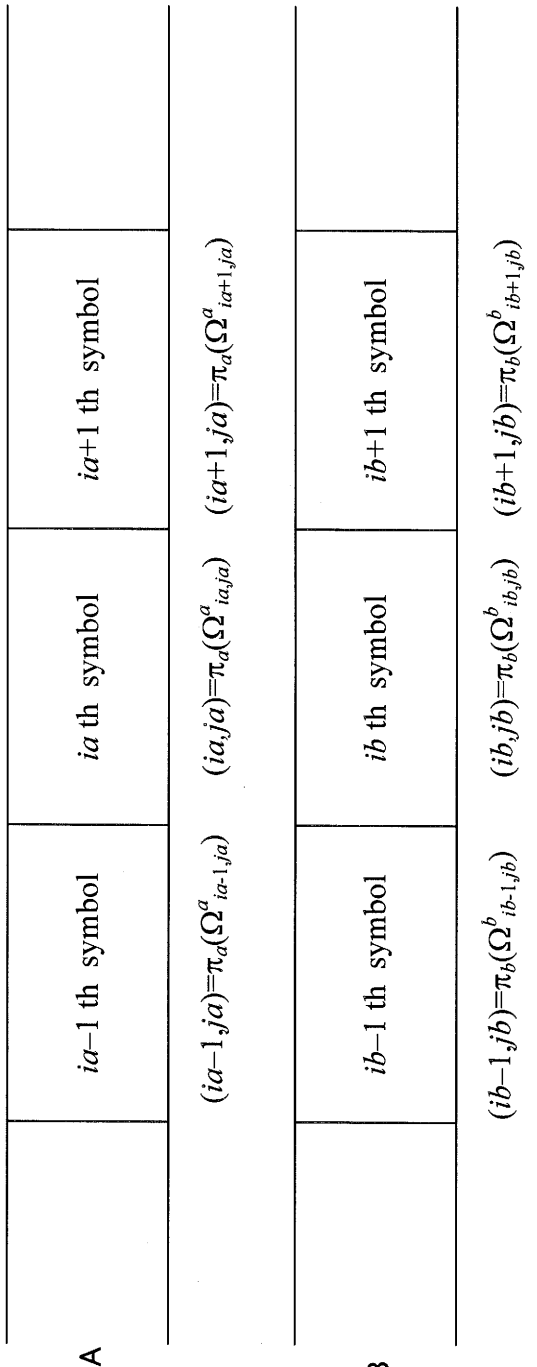

stream A
stream B
ia−1 th symbol
ia th symbol
ia+1 th symbol
ib−1 th symbol
ib th symbol
ib+1 th symbol
(ia−1,ja)=πa(Ωa ia-1,ja)
(ia,ja)=πa(Ωa ia,ja)
(ia+1,ja)=πa(Ωa ia+1,ja)
(ib−1,jb)=πb(Ωb ib-1,jb)
(ib,jb)=πb(Ωb ib,jb)
(ib+1,jb)=πb(Ωb ib+1,jb)
time

FIG. 3

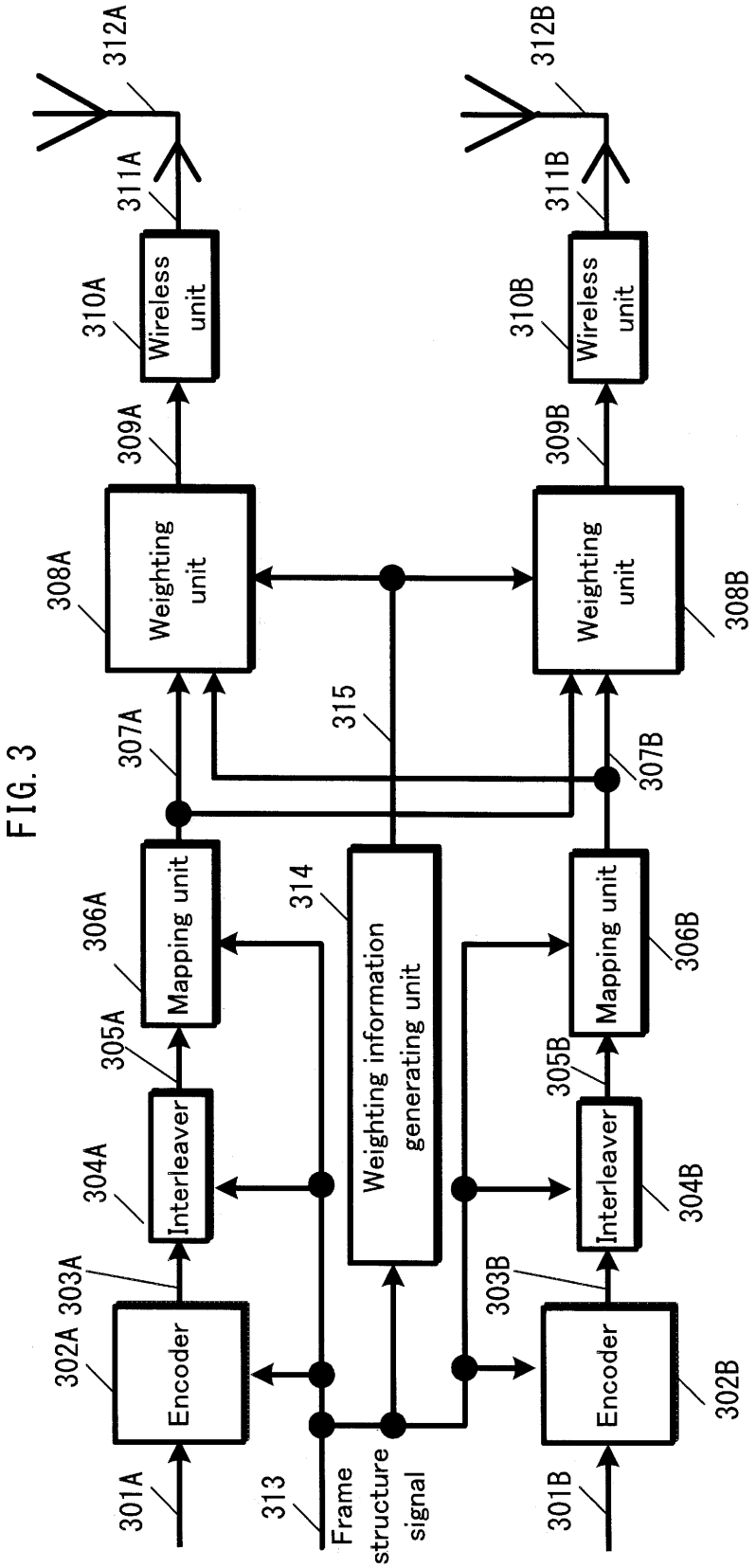

312A
312B
311A
311B
310A
310B
Wireless unit
Wireless unit
309A
309B
308A
Weighting unit
Weighting unit
308B
315
307A
307B
306A
Mapping unit
314
Weighting information generating unit
Mapping unit
306B
305A
305B
304A
Interleaver
Interleaver
304B
303A
303B
302A
Encoder
Encoder
302B
301A
313
Frame structure signal
301B

FIG. 4

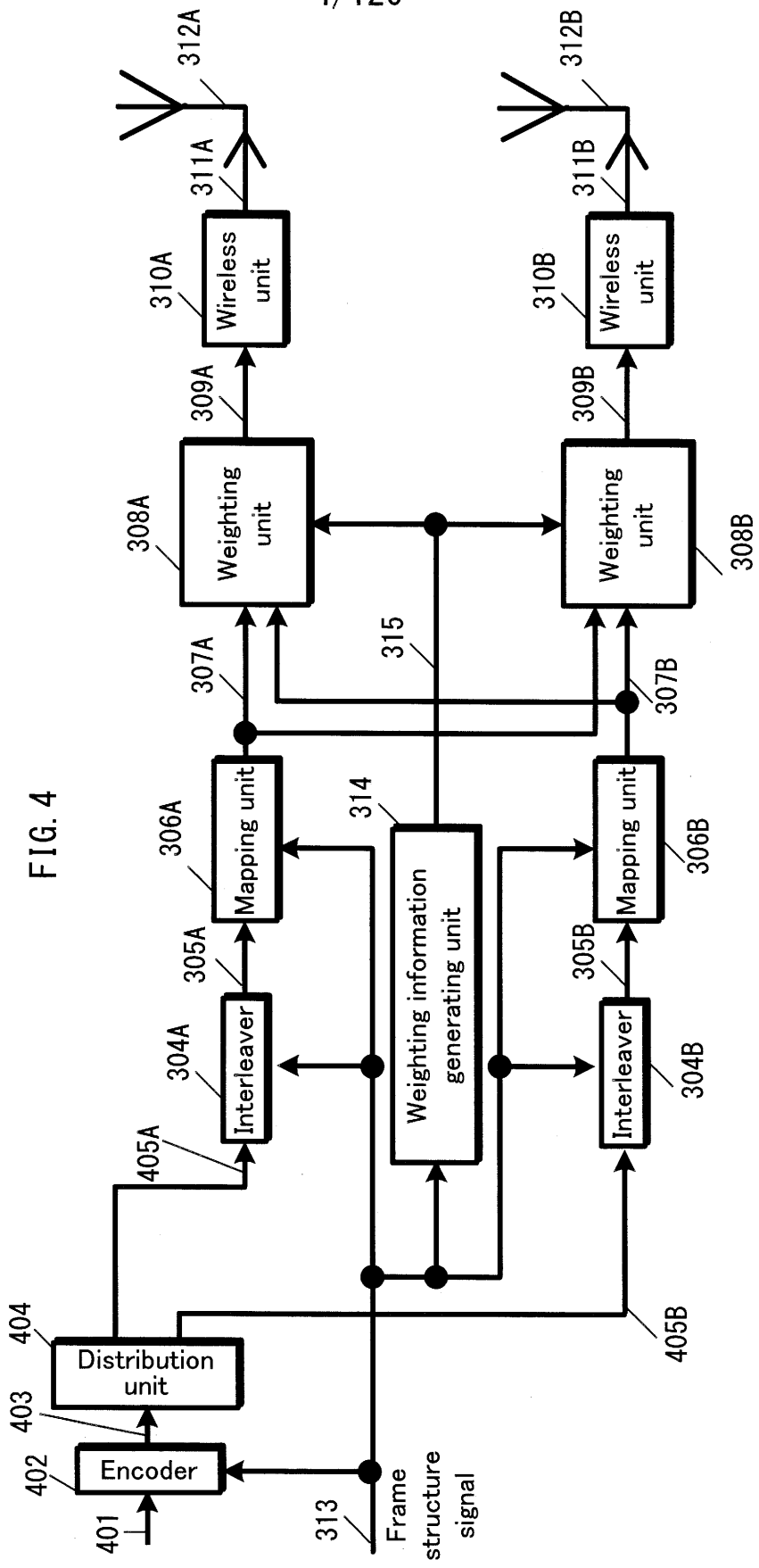

312A
312B
311A
311B
310A
310B
Wireless unit
Wireless unit
309A
309B
308A
Weighting unit
Weighting unit
308B
315
307A
307B
306A
Mapping unit
314
Weighting information generating unit
Mapping unit
306B
305A
305B
304A
Interleaver
Interleaver
304B
405A
405B
404
Distribution unit
403
402
Encoder
401
313
Frame structure signal

FIG. 5

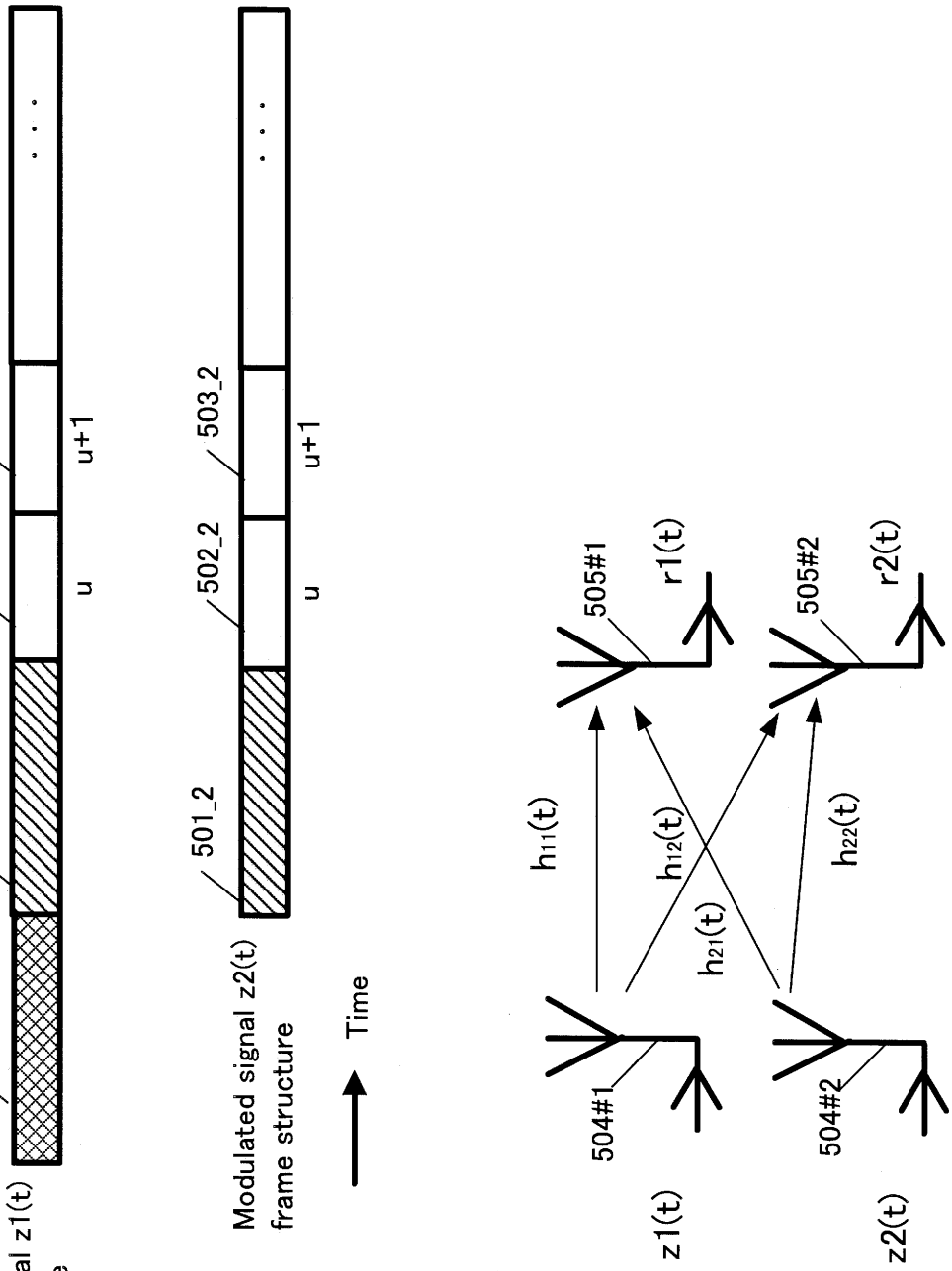
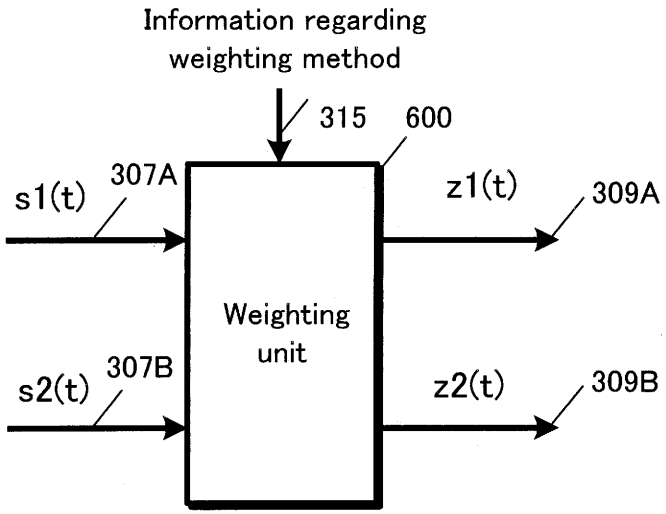
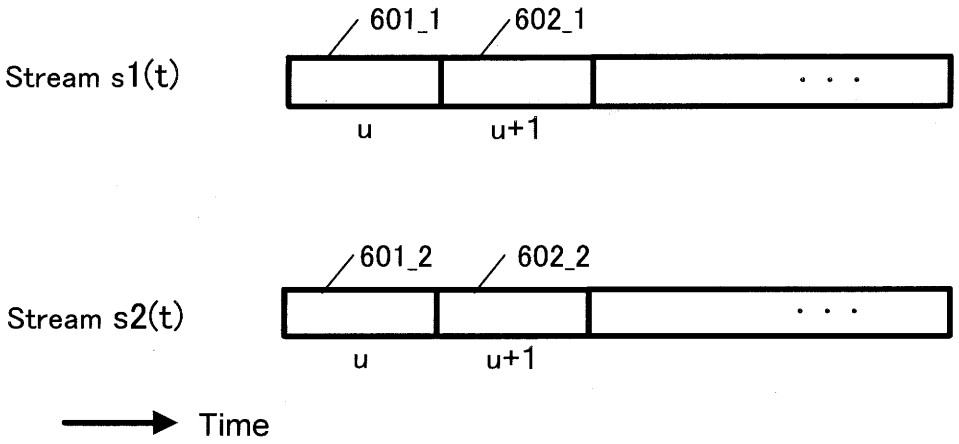

Modulated signal z1(t)
frame structure
500_1
501_1
502_1
503_1
u
u+1
Modulated signal z2(t)
frame structure
501_2
502_2
503_2
u
u+1
Time
504#1
504#2
505#1
505#2
z1(t)
z2(t)
r1(t)
r2(t)
h11(t)
h12(t)
h21(t)
h22(t)

FIG. 6





time 4i

$$W(4i)=\frac{1}{\sqrt{2}}\begin{pmatrix} e^{j0} & e^{j0} \\ e^{j0} & e^{j\frac{3}{4}\pi} \end{pmatrix}$$

time 4i+1

$$W(4i+1)=\frac{1}{\sqrt{2}}\begin{pmatrix} e^{j0} & e^{j0} \\ e^{j\frac{3}{4}\pi} & e^{j0} \end{pmatrix}$$

time 4i+2

$$W(4i+2)=\frac{1}{\sqrt{2}}\begin{pmatrix} e^{j0} & e^{j\frac{3}{4}\pi} \\ e^{j0} & e^{j0} \end{pmatrix}$$

time 4i+3

$$W(4i+3)=\frac{1}{\sqrt{2}}\begin{pmatrix} e^{j\frac{3}{4}\pi} & e^{j0} \\ e^{j0} & e^{j0} \end{pmatrix}$$

FIG. 7

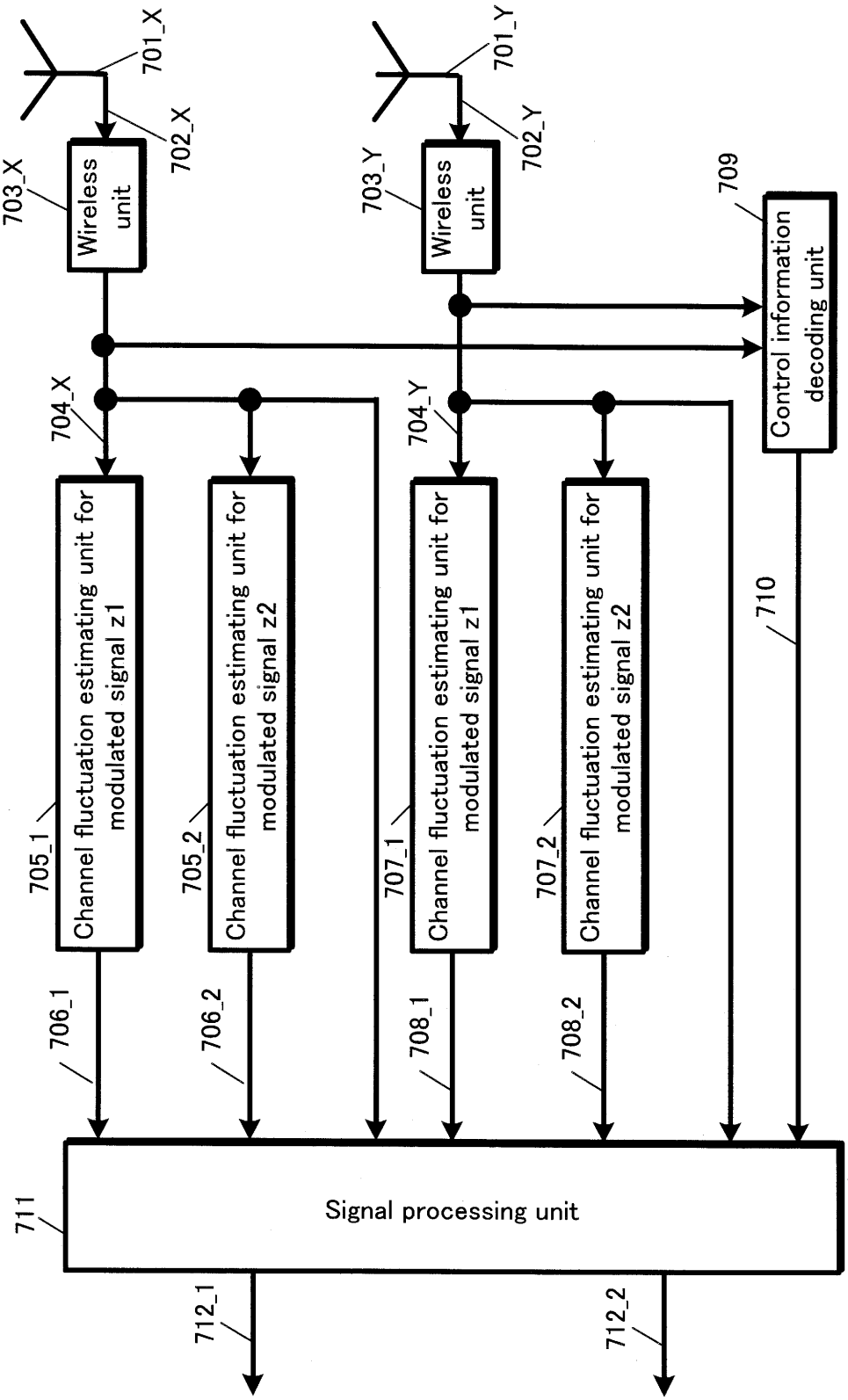

701_X
701_Y
702_X
702_Y
703_X
703_Y
Wireless unit
Wireless unit
709
Control information decoding unit
704_X
704_Y
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
705_1
705_2
707_1
707_2
710
706_1
706_2
708_1
708_2
Signal processing unit
711
712_1
712_2

FIG. 8

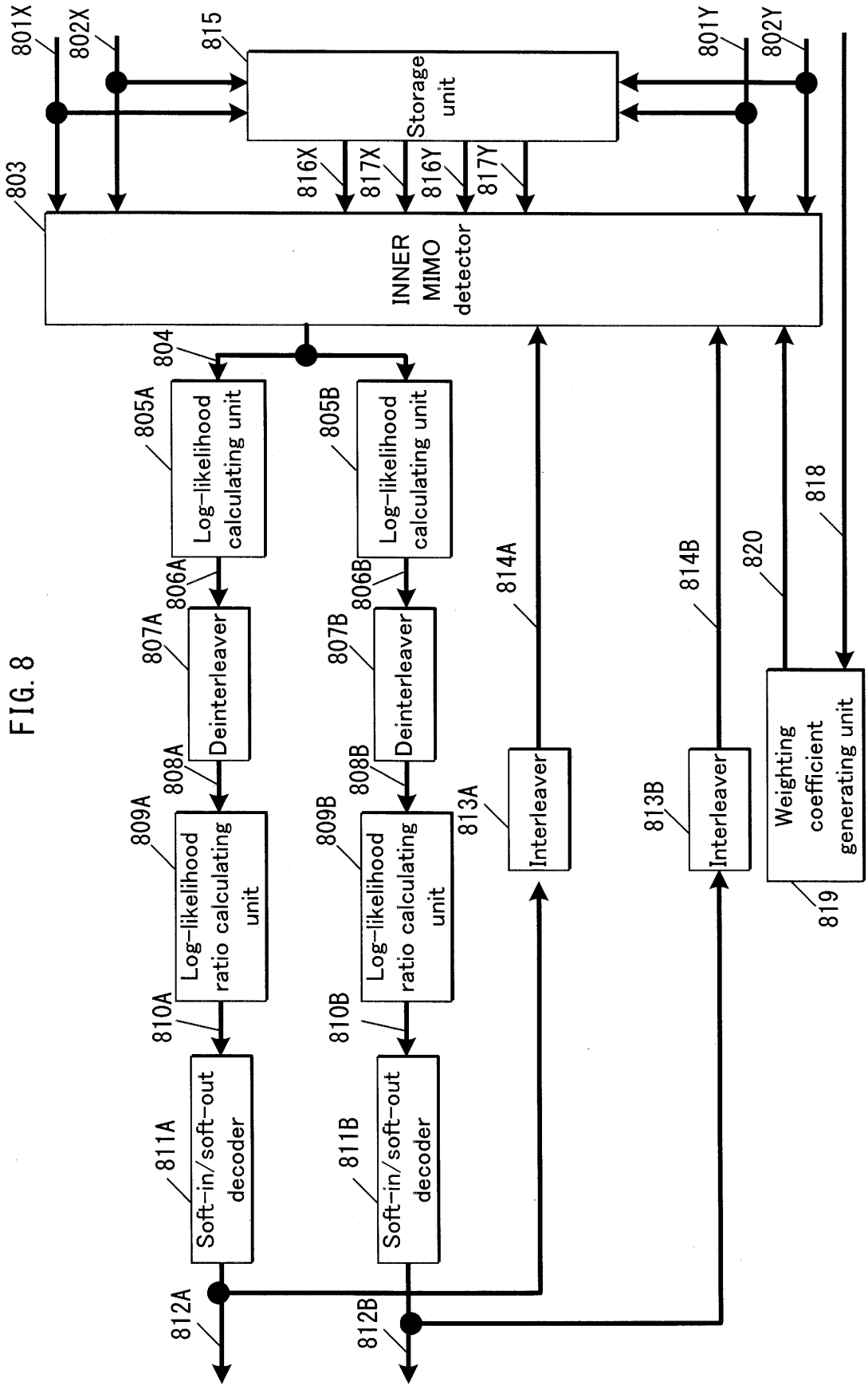

801X
802X
815
Storage unit
801Y
802Y
803
816X
817X
816Y
817Y
INNER MIMO detector
804
805A
Log-likelihood calculating unit
805B
Log-likelihood calculating unit
806A
806B
807A
Deinterleaver
807B
Deinterleaver
808A
808B
809A
Log-likelihood ratio calculating unit
809B
Log-likelihood ratio calculating unit
810A
810B
811A
Soft-in/soft-out decoder
811B
Soft-in/soft-out decoder
812A
812B
813A
Interleaver
813B
Interleaver
814A
814B
818
820
Weighting coefficient generating unit
819

FIG. 9

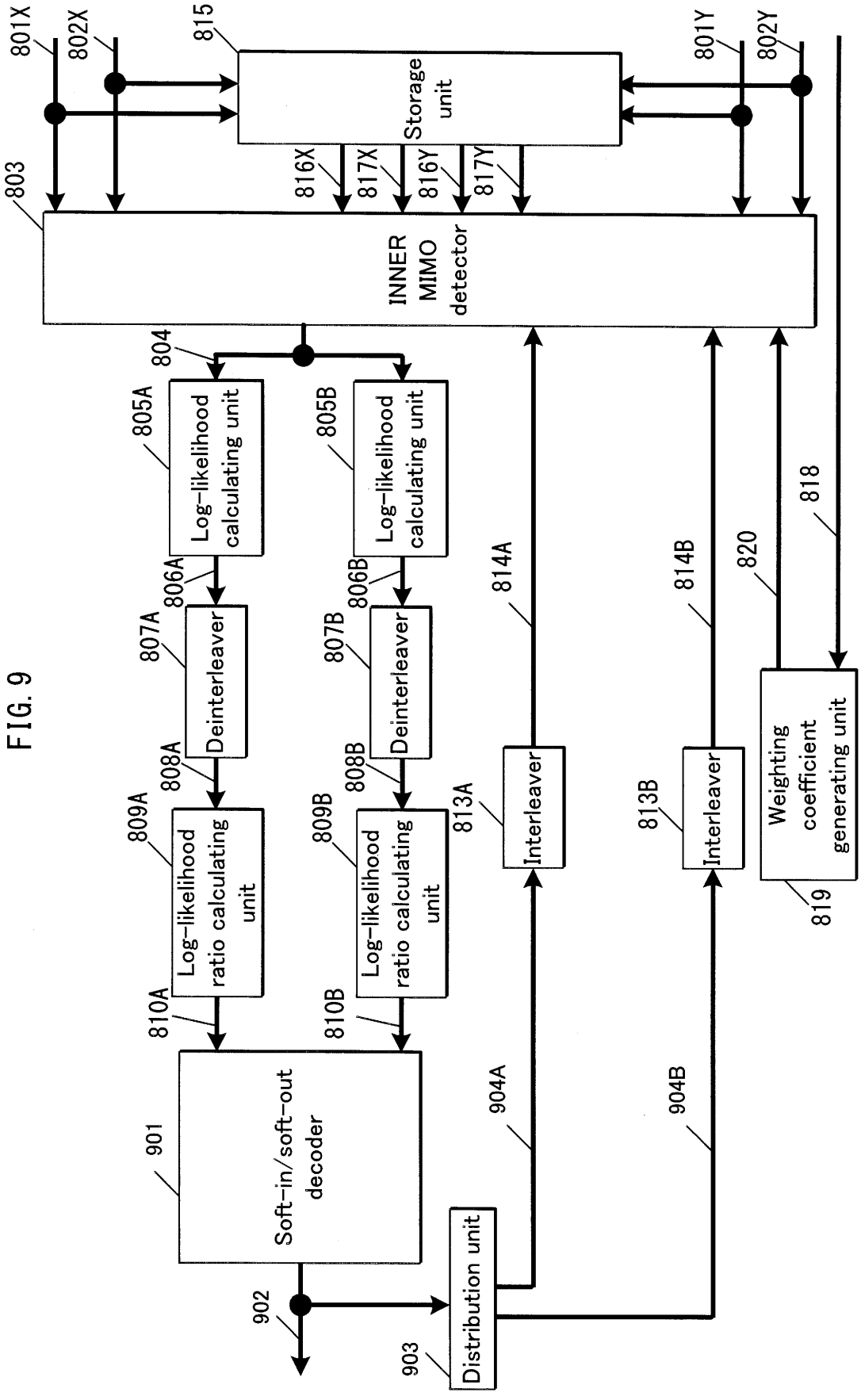

801X
802X
815
Storage unit
801Y
802Y
816X
817X
816Y
817Y
803
INNER MIMO detector
804
805A
Log-likelihood calculating unit
805B
Log-likelihood calculating unit
806A
806B
807A
Deinterleaver
807B
Deinterleaver
808A
808B
809A
Log-likelihood ratio calculating unit
809B
Log-likelihood ratio calculating unit
810A
810B
813A
Interleaver
813B
Interleaver
814A
814B
820
818
Weighting coefficient generating unit
819
901
Soft-in/soft-out decoder
902
903
Distribution unit
904A
904B

FIG. 10

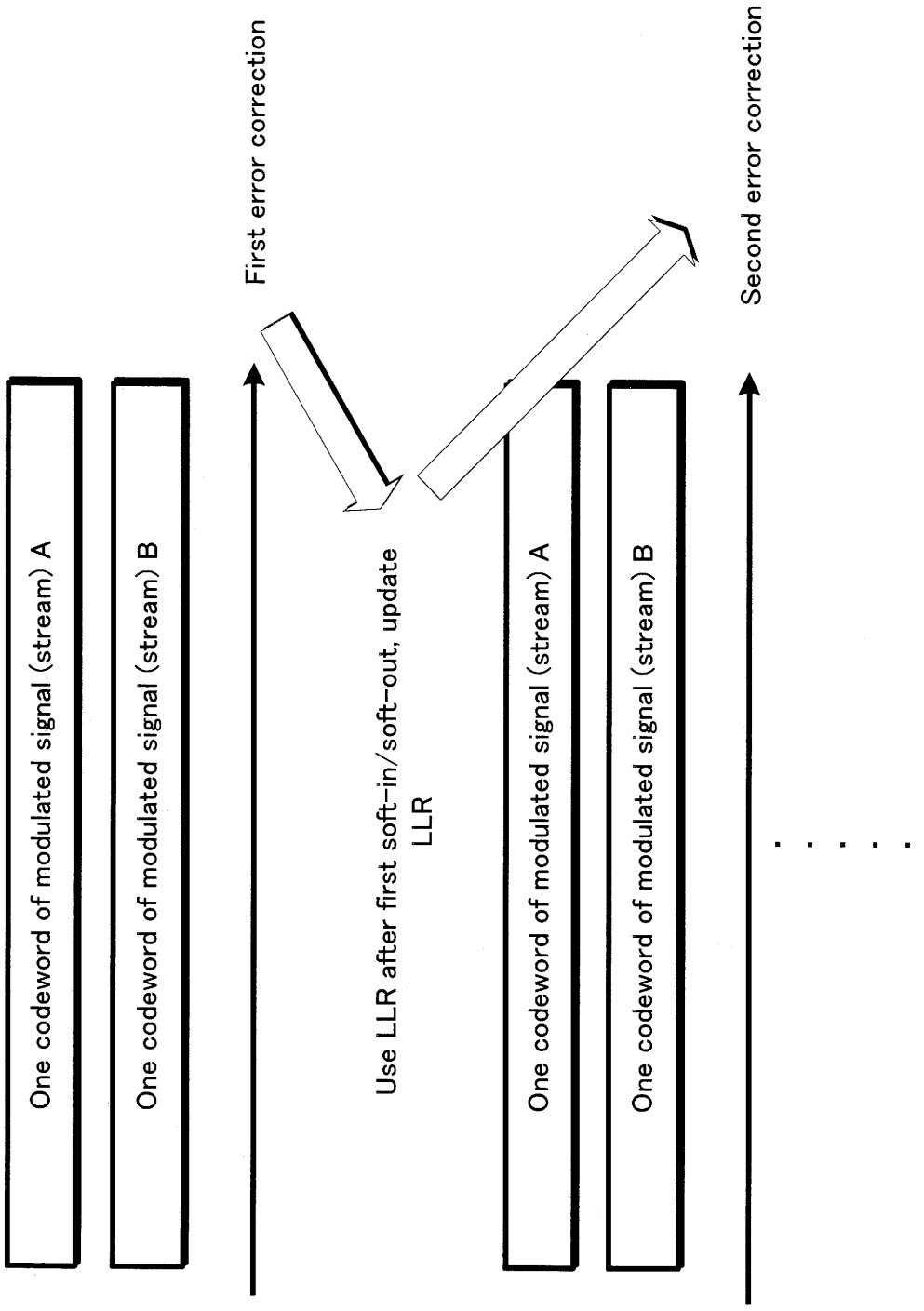

One codeword of modulated signal (stream) A
One codeword of modulated signal (stream) B
First error correction
Use LLR after first soft-in/soft-out, update LLR
One codeword of modulated signal (stream) A
One codeword of modulated signal (stream) B
Second error correction

FIG. 11

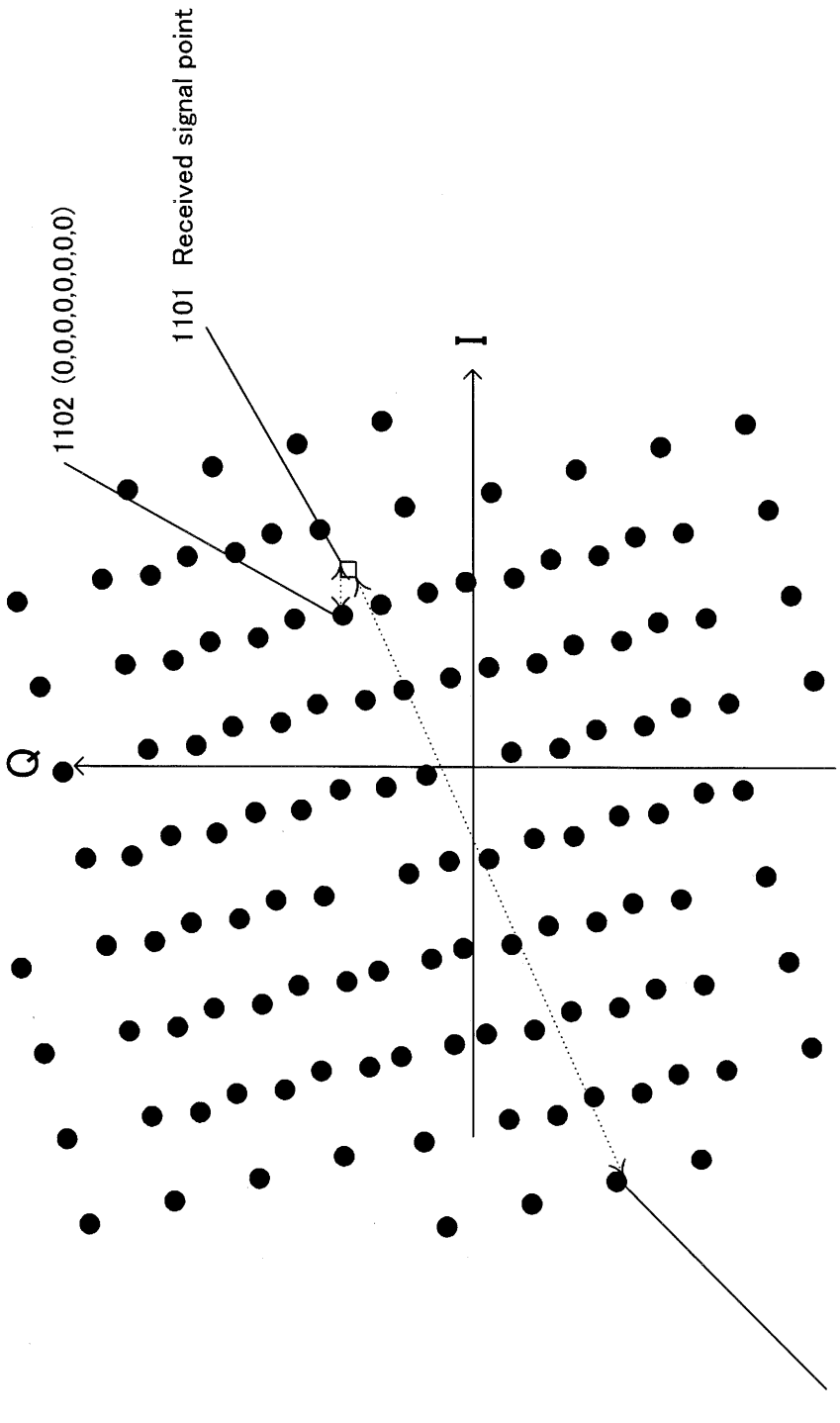


FIG. 12A

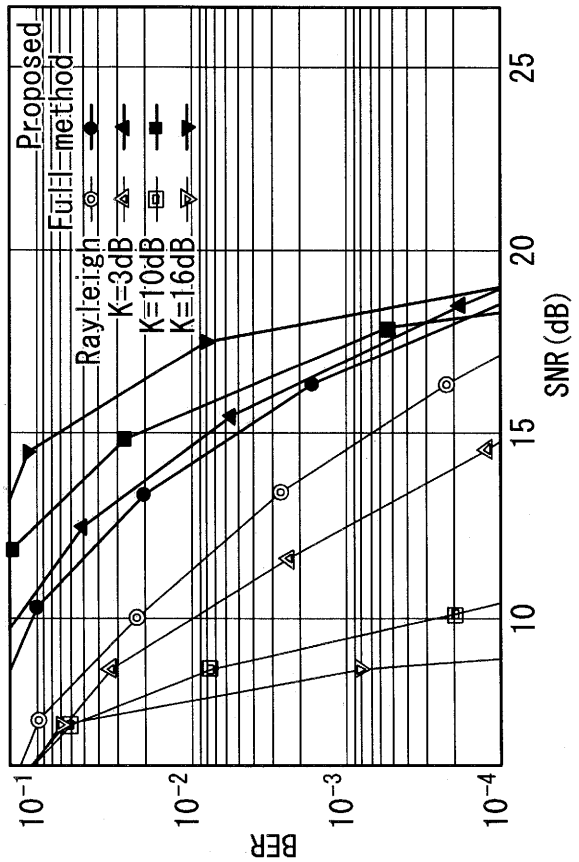


FIG. 12B

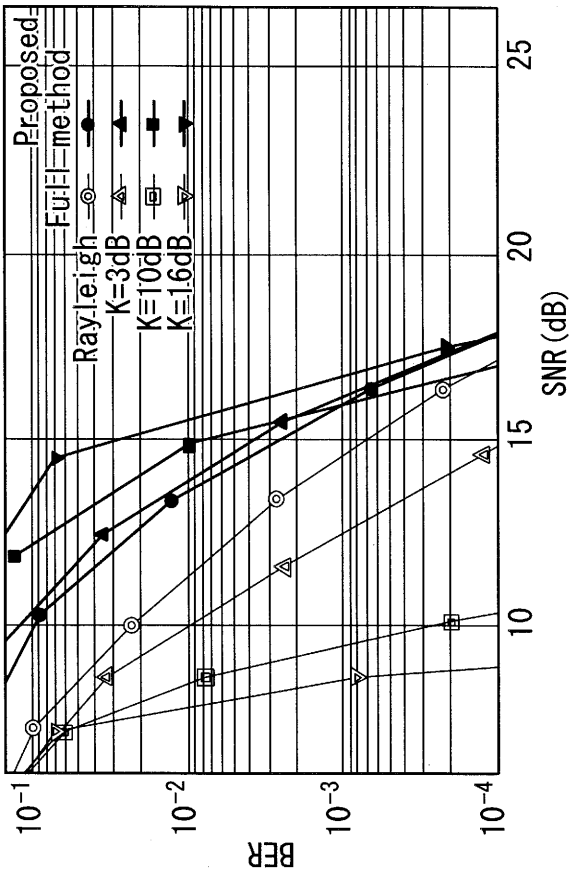


FIG. 13

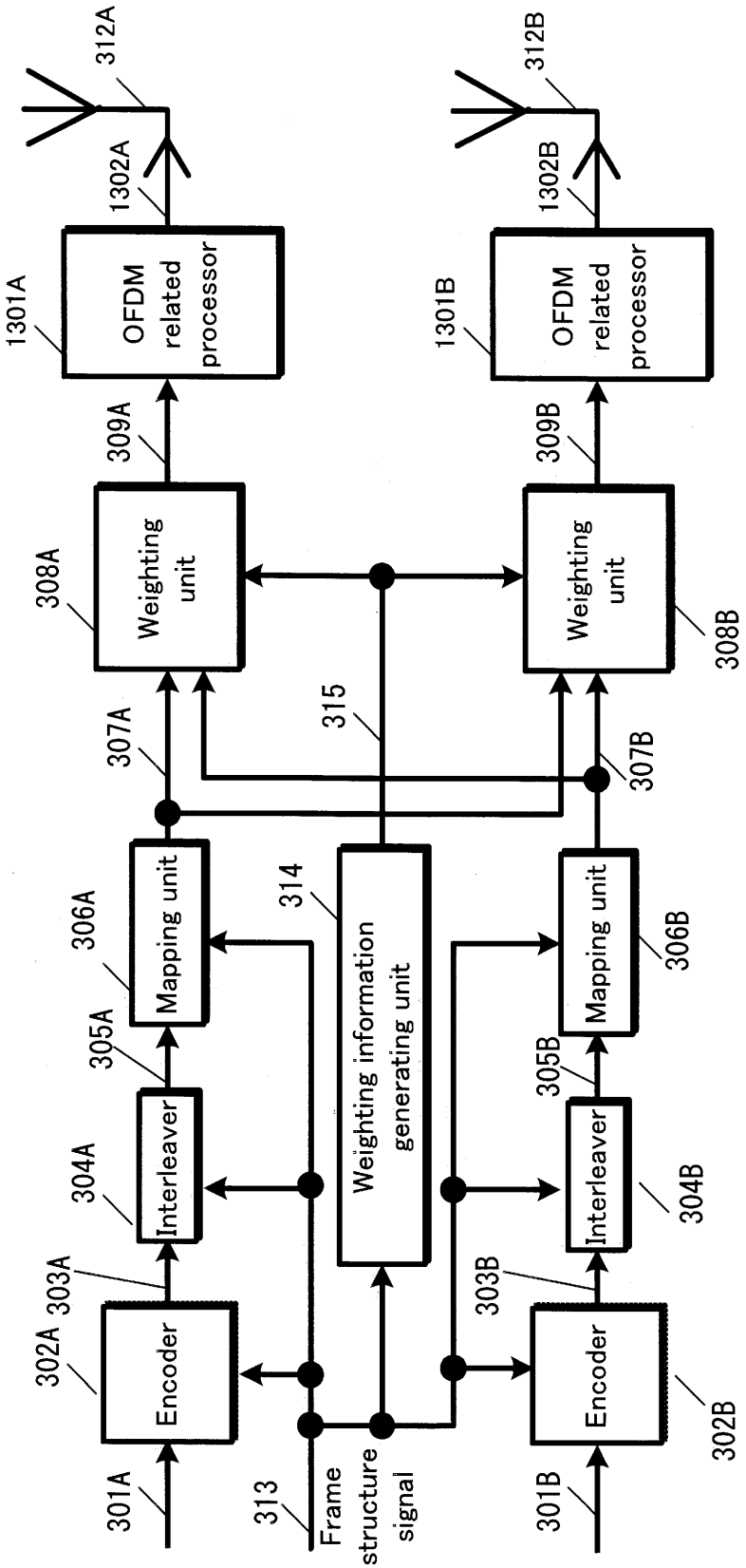

312A
312B
1302A
1302B
1301A
1301B
OFDM related processor
OFDM related processor
309A
309B
308A
Weighting unit
Weighting unit
308B
315
307A
307B
306A
Mapping unit
314
Weighting information generating unit
Mapping unit
306B
305A
305B
304A
Interleaver
Interleaver
304B
303A
303B
302A
Encoder
Encoder
302B
301A
313
Frame structure signal
301B

FIG. 14

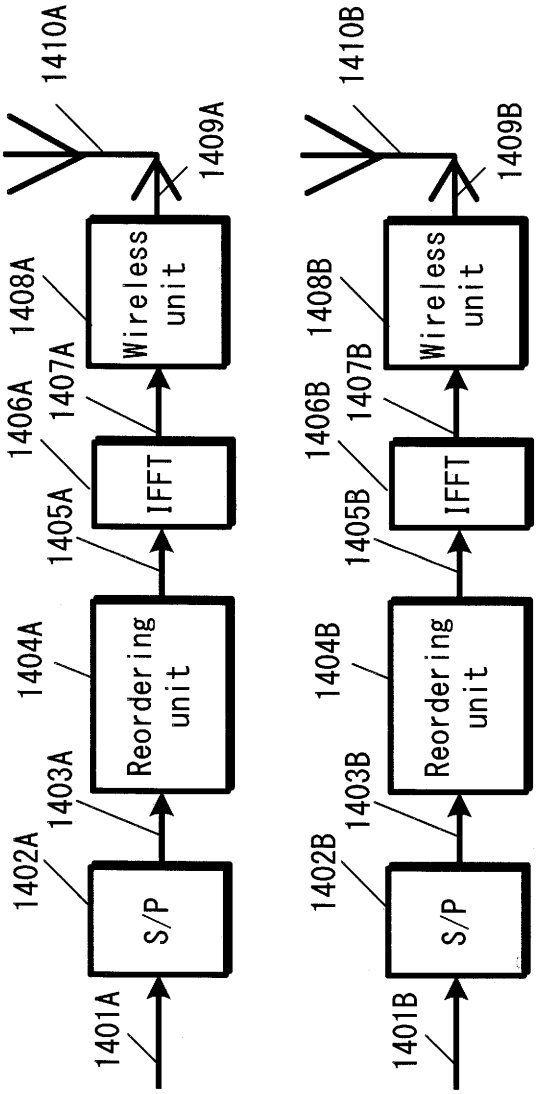

1401A
1401B
S/P
1402A
1402B
1403A
1403B
Reordering unit
1404A
1404B
1405A
1405B
IFFT
1406A
1406B
1407A
1407B
Wireless unit
1408A
1408B
1409A
1409B
1410A
1410B

FIG. 15A

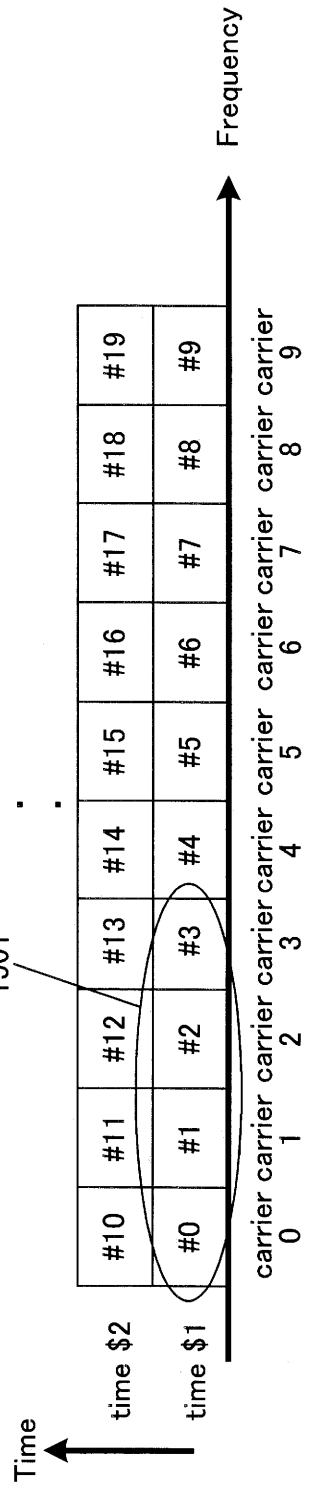


FIG. 15B

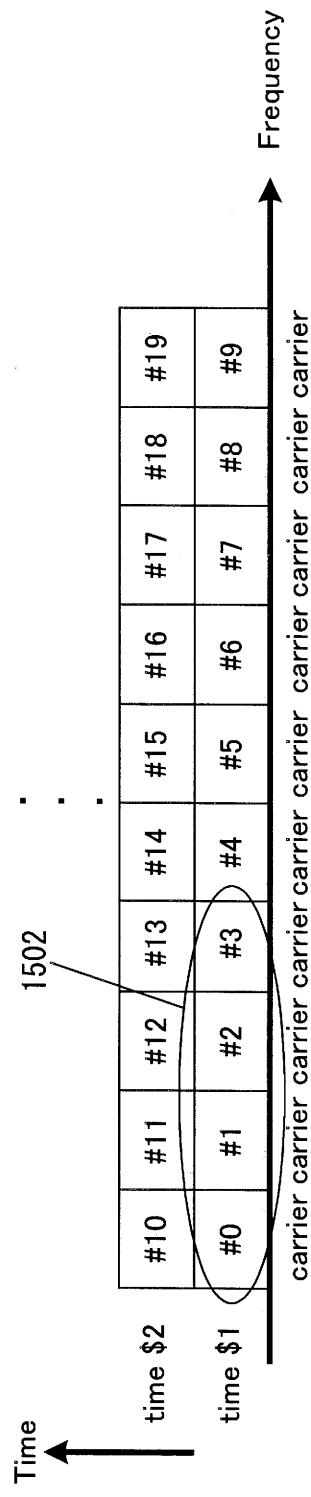


FIG. 16A

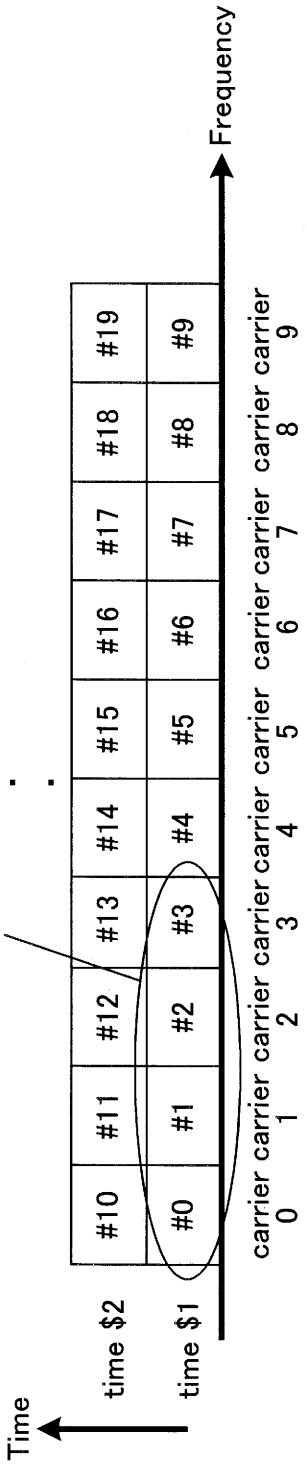


FIG. 16B

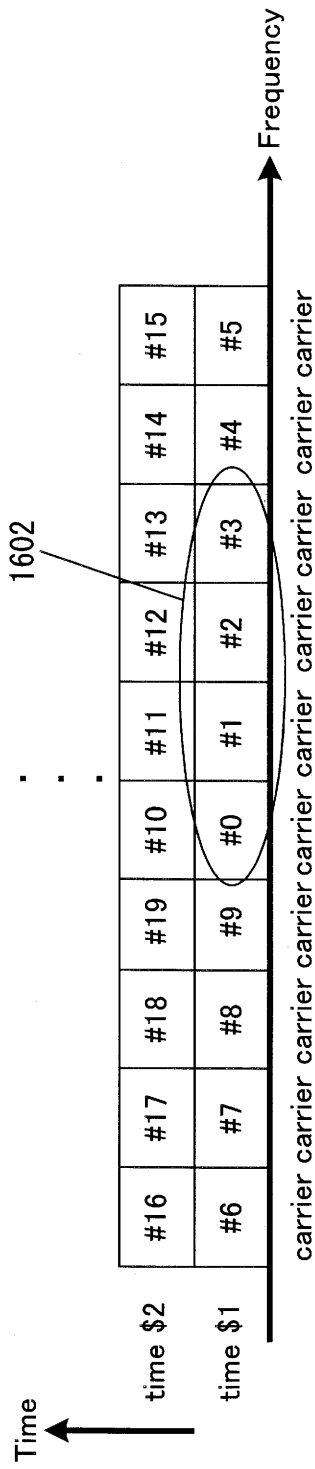


FIG. 17A

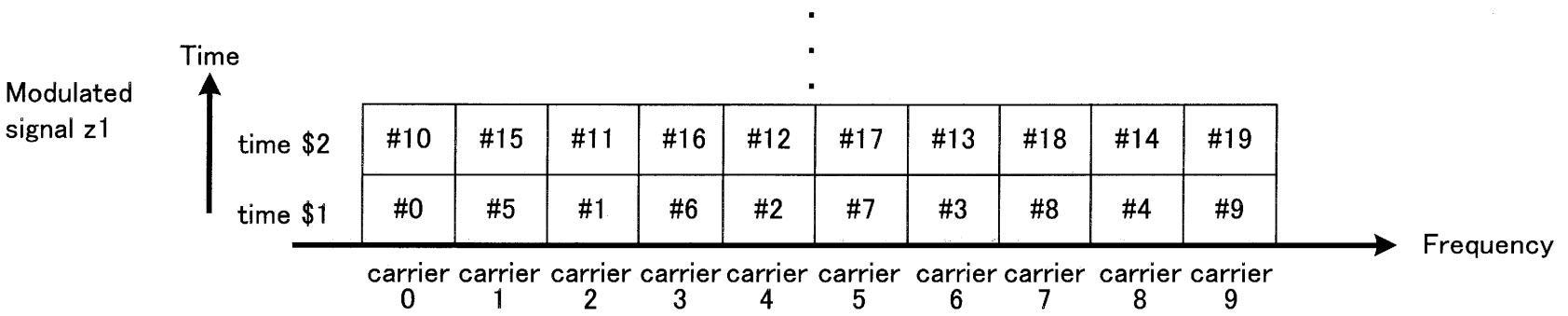


FIG. 17B

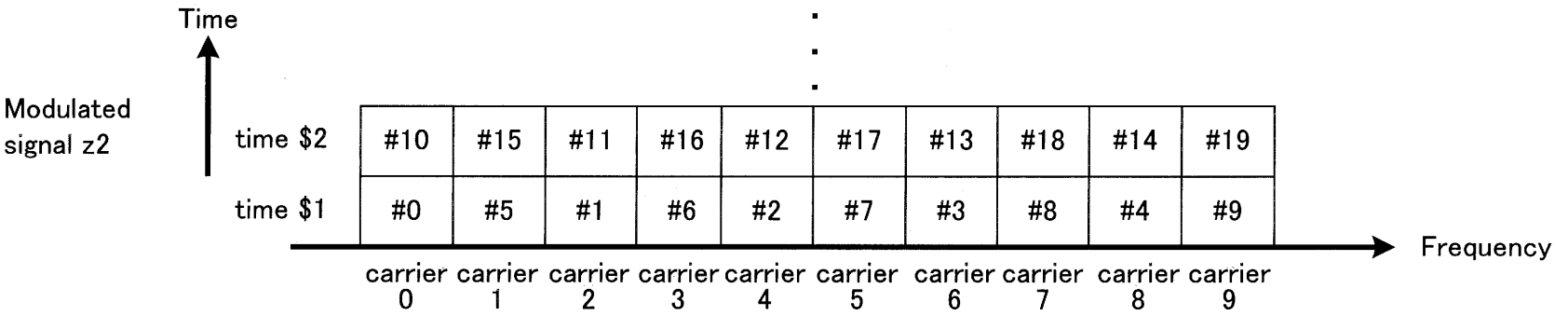


FIG. 18A

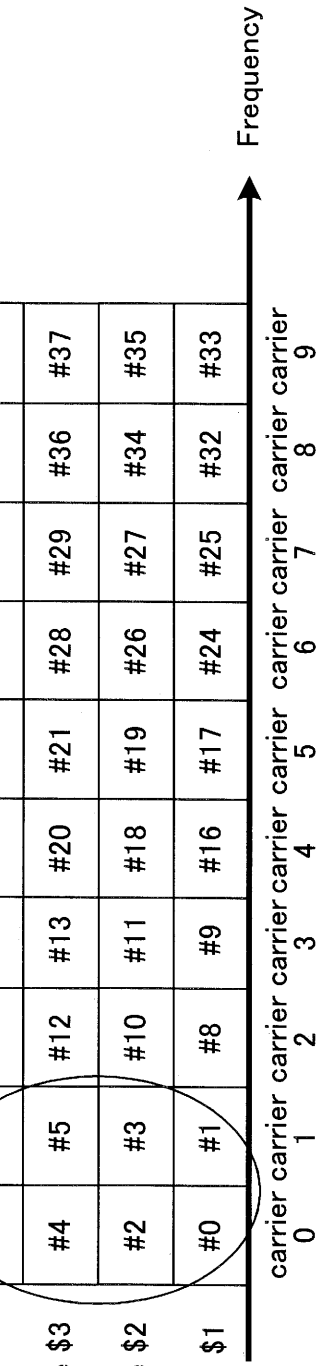


FIG. 18B

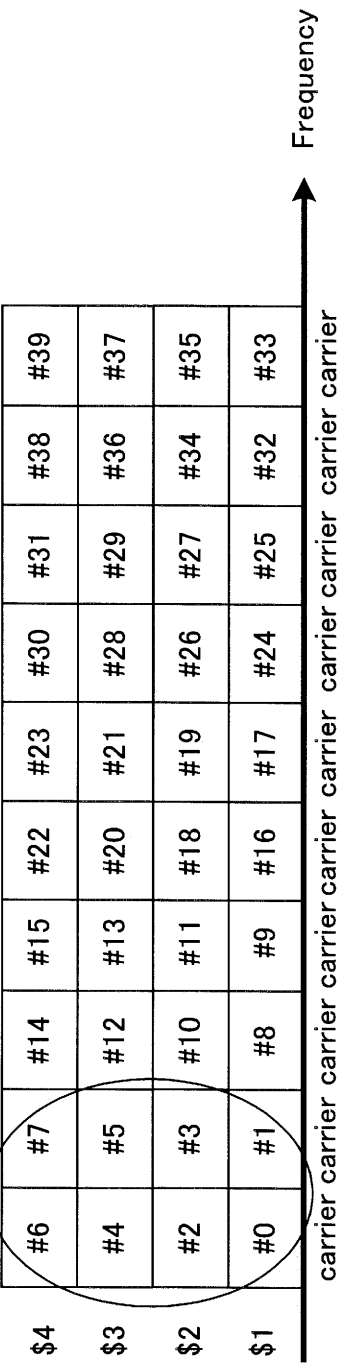


FIG. 19A

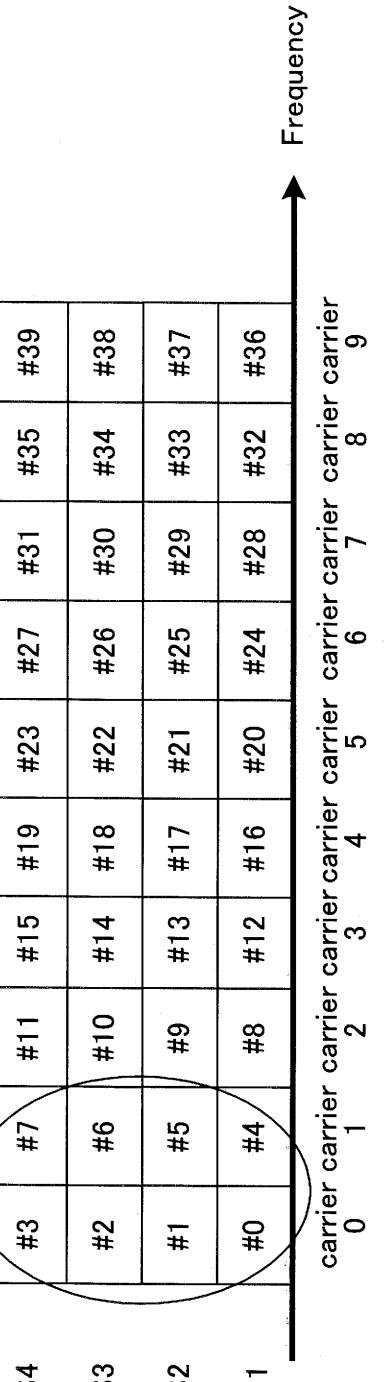


FIG. 19B

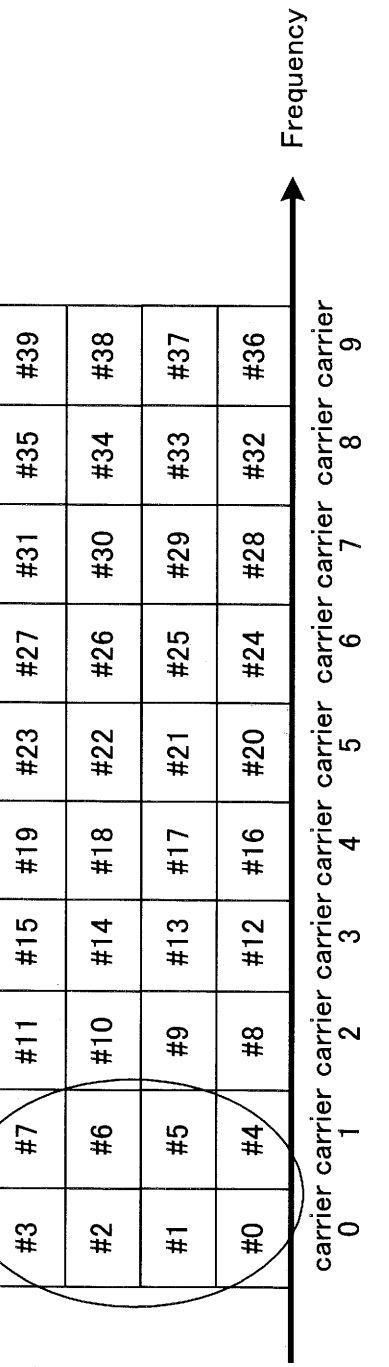


FIG. 20

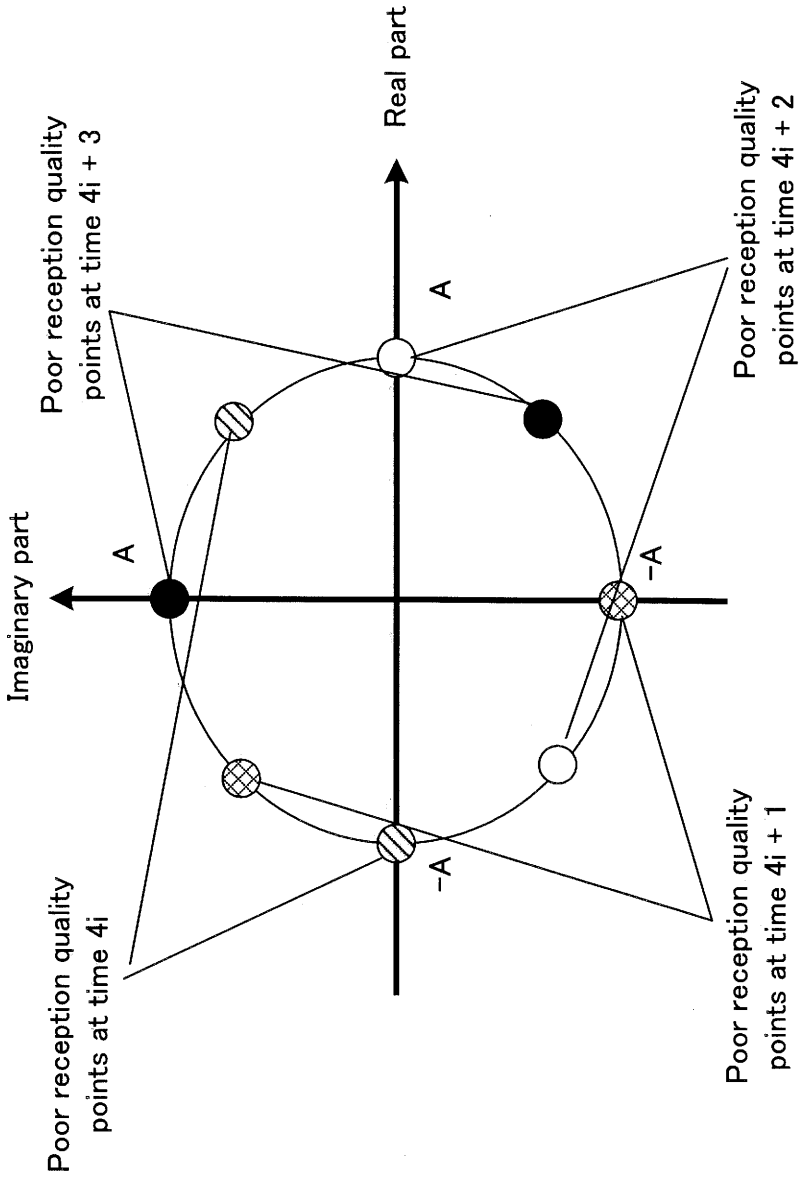

Real part
Imaginary part
A
A
-A
-A
Poor reception quality points at time 4i + 3
Poor reception quality points at time 4i + 2
Poor reception quality points at time 4i
Poor reception quality points at time 4i + 1

FIG. 21

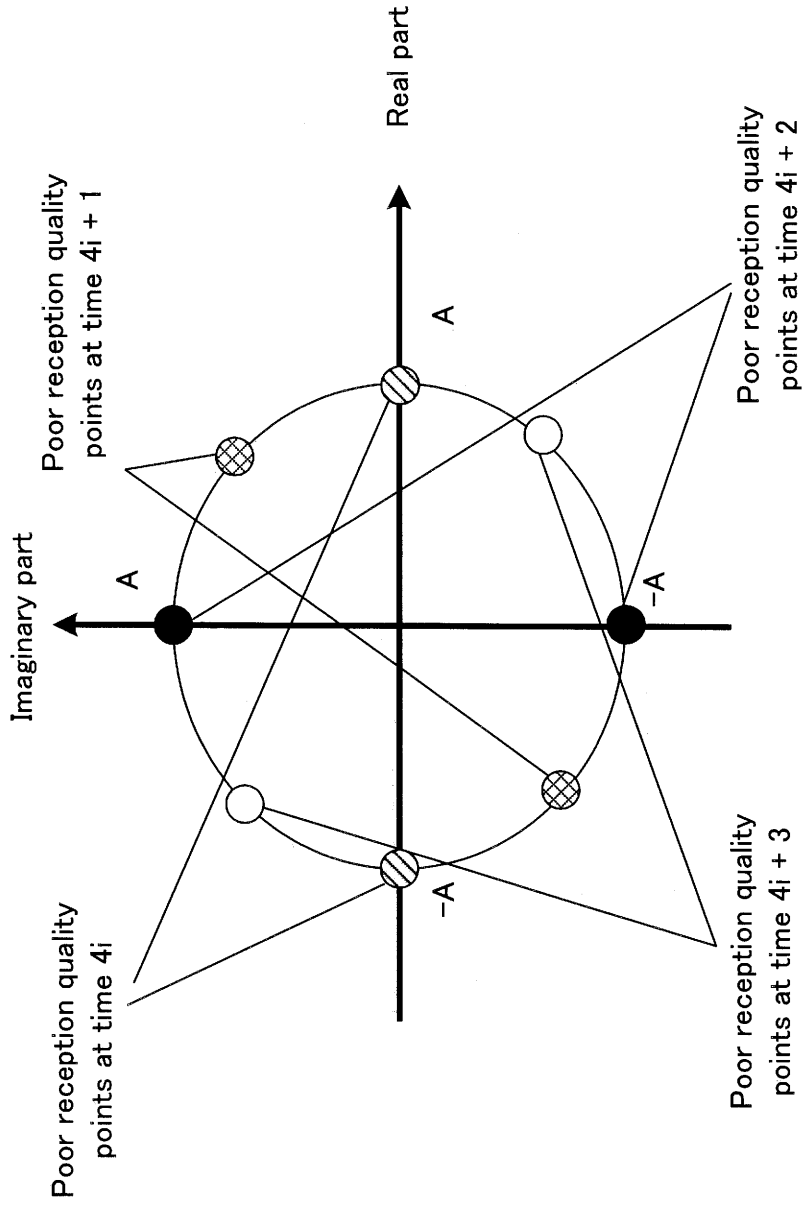

Real part
Imaginary part
A
A
-A
-A
Poor reception quality points at time 4i + 1
Poor reception quality points at time 4i + 2
Poor reception quality points at time 4i
Poor reception quality points at time 4i + 3

FIG. 22

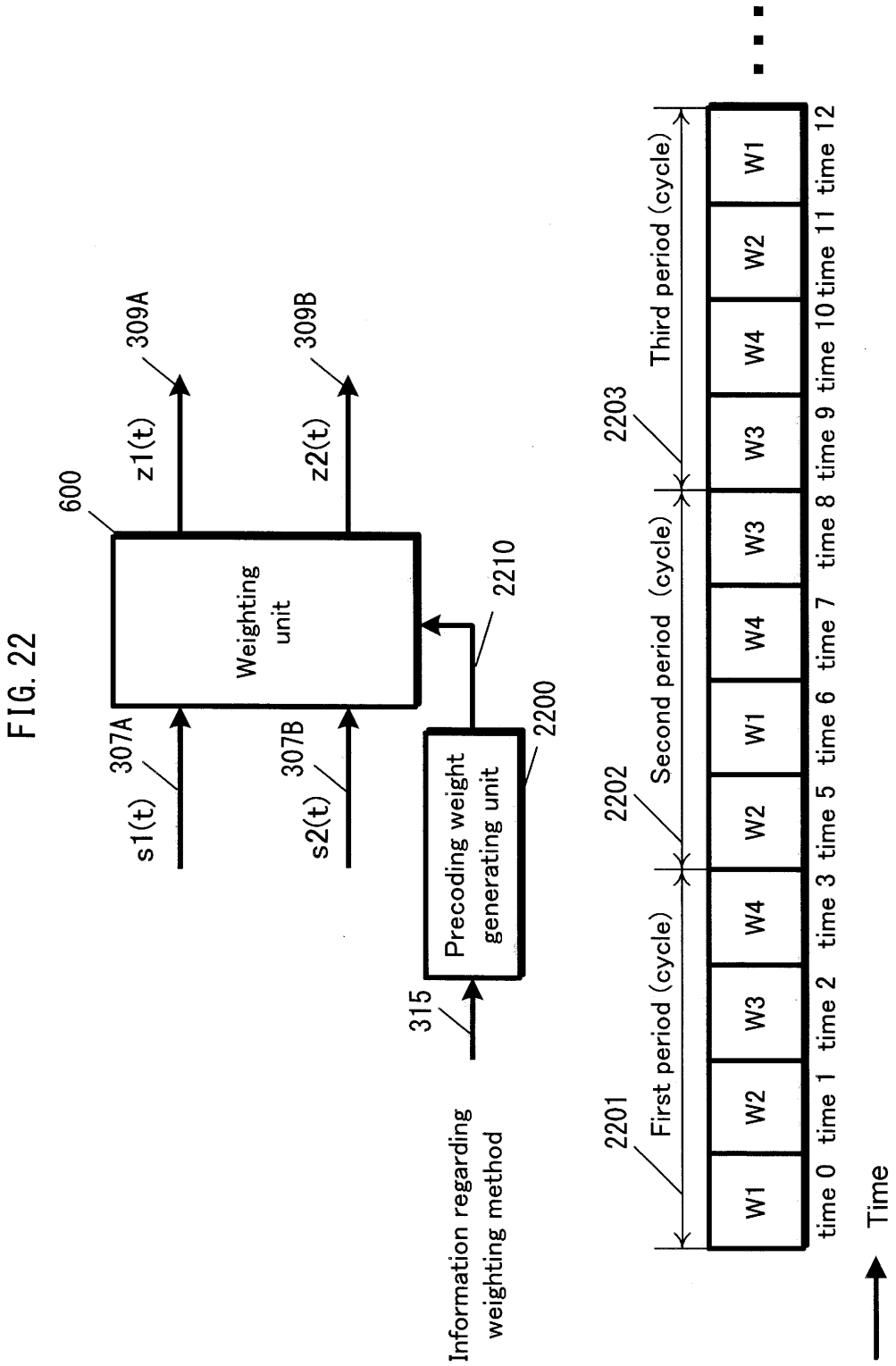

600
Weighting unit
307A
307B
309A
309B
s1(t)
s2(t)
z1(t)
z2(t)
2210
2200
Precoding weight generating unit
315
Information regarding weighting method
2201
2202
2203
First period (cycle)
Second period (cycle)
Third period (cycle)
W1
W2
W3
W4
time 0 time 1 time 2 time 3 time 5 time 6 time 7 time 8 time 9 time 10 time 11 time 12
Time

FIG. 23

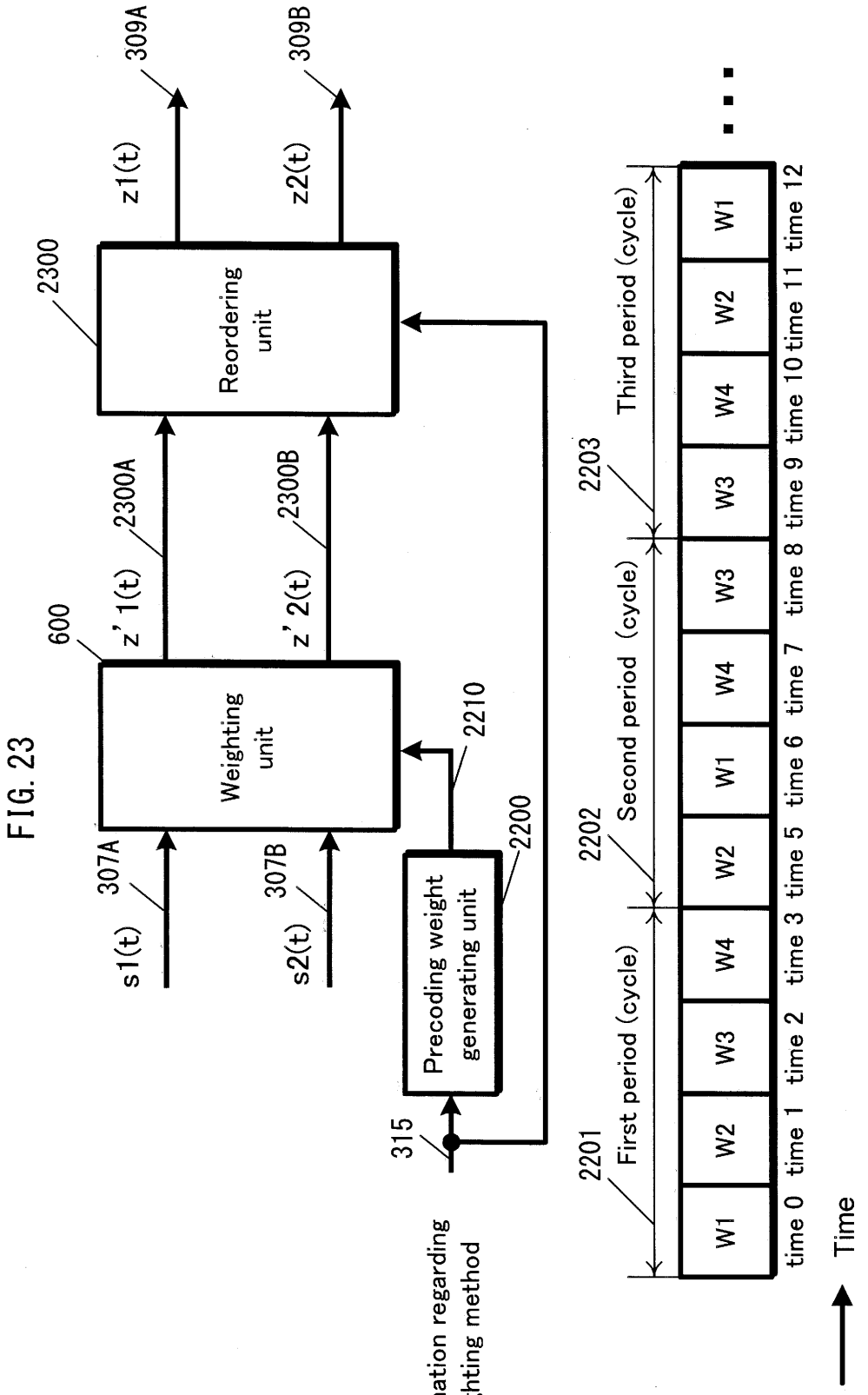

309A
309B
z1(t)
z2(t)
2300
Reordering unit
2300A
2300B
z'1(t)
z'2(t)
600
Weighting unit
2210
2200
307A
307B
s1(t)
s2(t)
Precoding weight generating unit
315
Information regarding weighting method
2201
2202
2203
First period (cycle)
Second period (cycle)
Third period (cycle)
W1
W2
W3
W4
time 0
time 1
time 2
time 3
time 5
time 6
time 7
time 8
time 9
time 10
time 11
time 12
Time

FIG. 24B

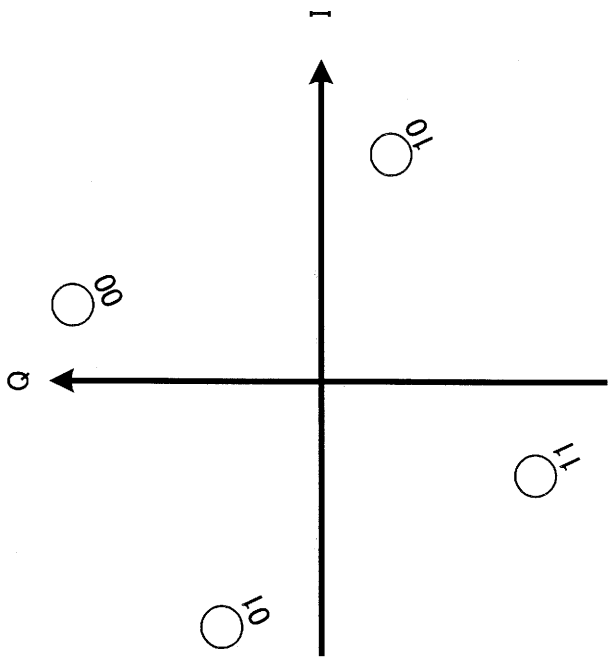


FIG. 24A

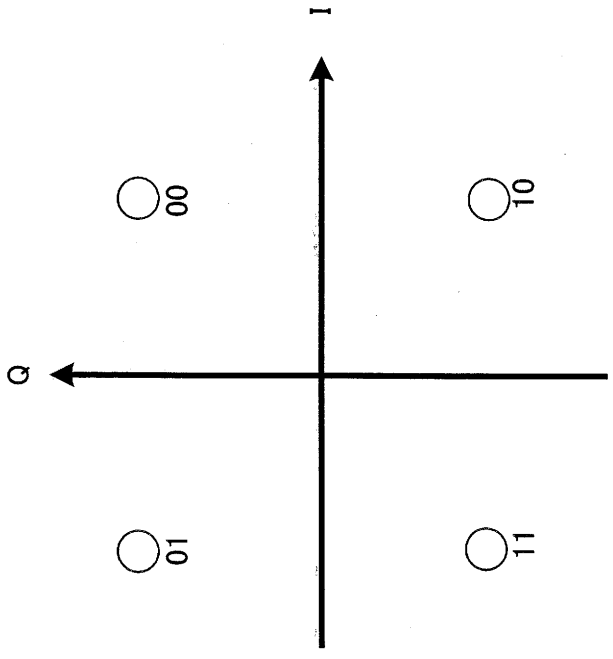


FIG. 25B

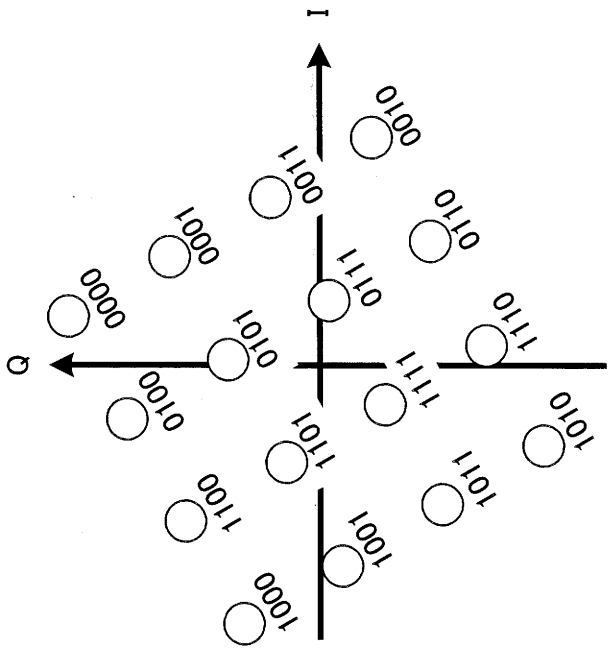


FIG. 25A

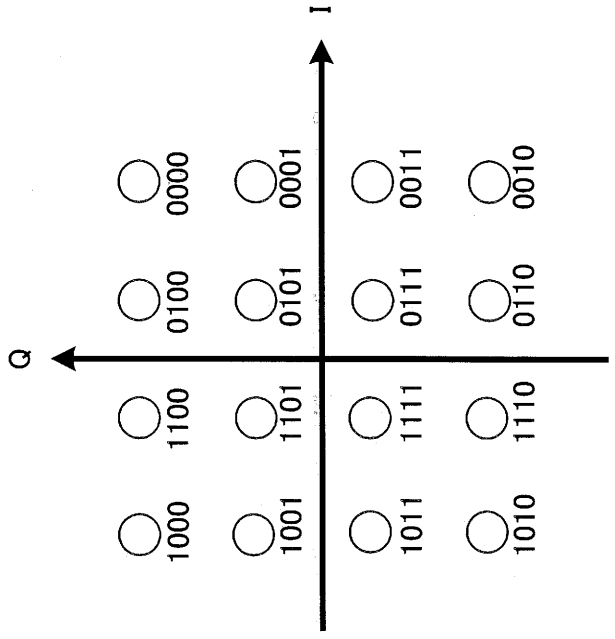


FIG. 26

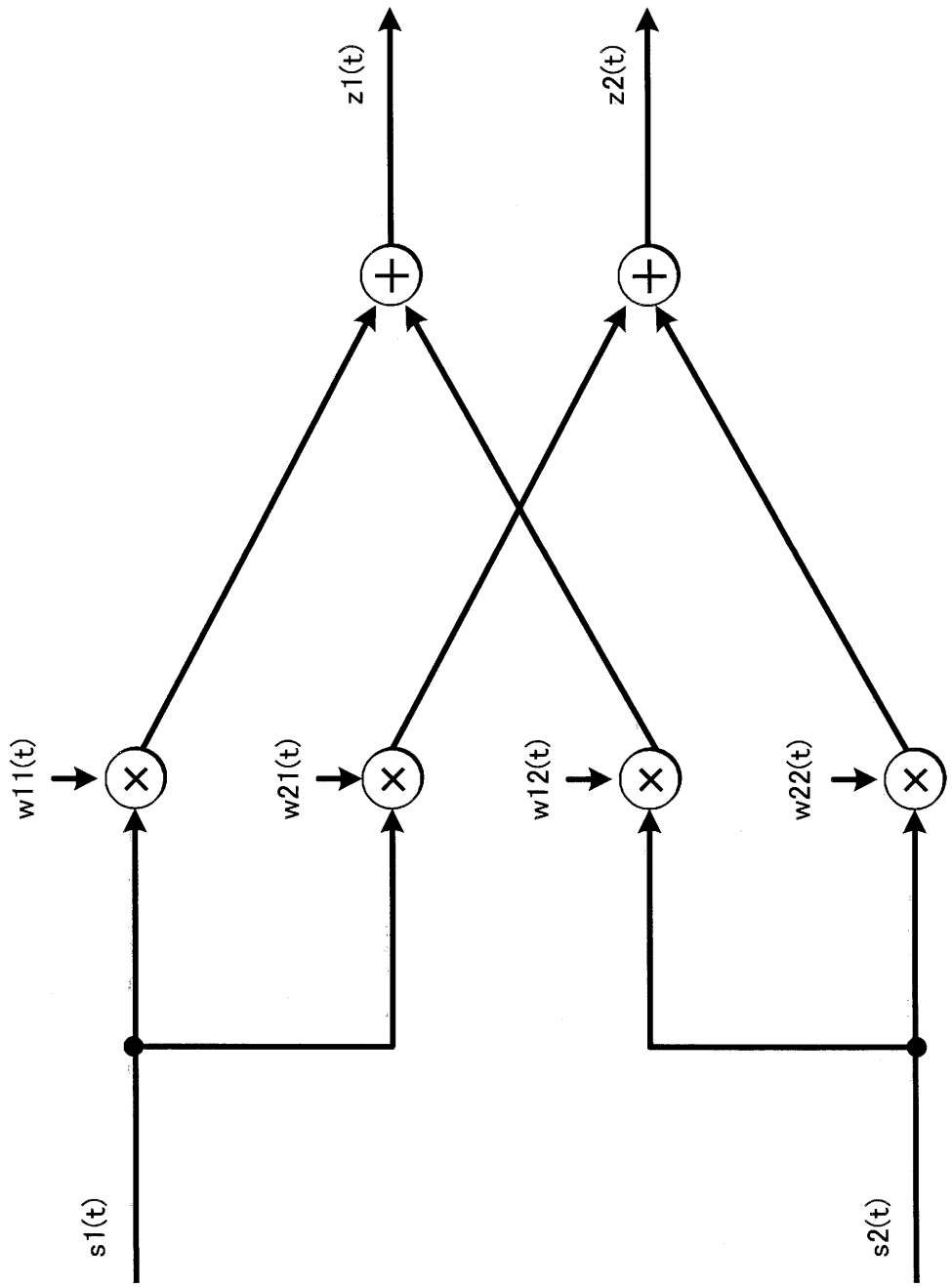


FIG. 27

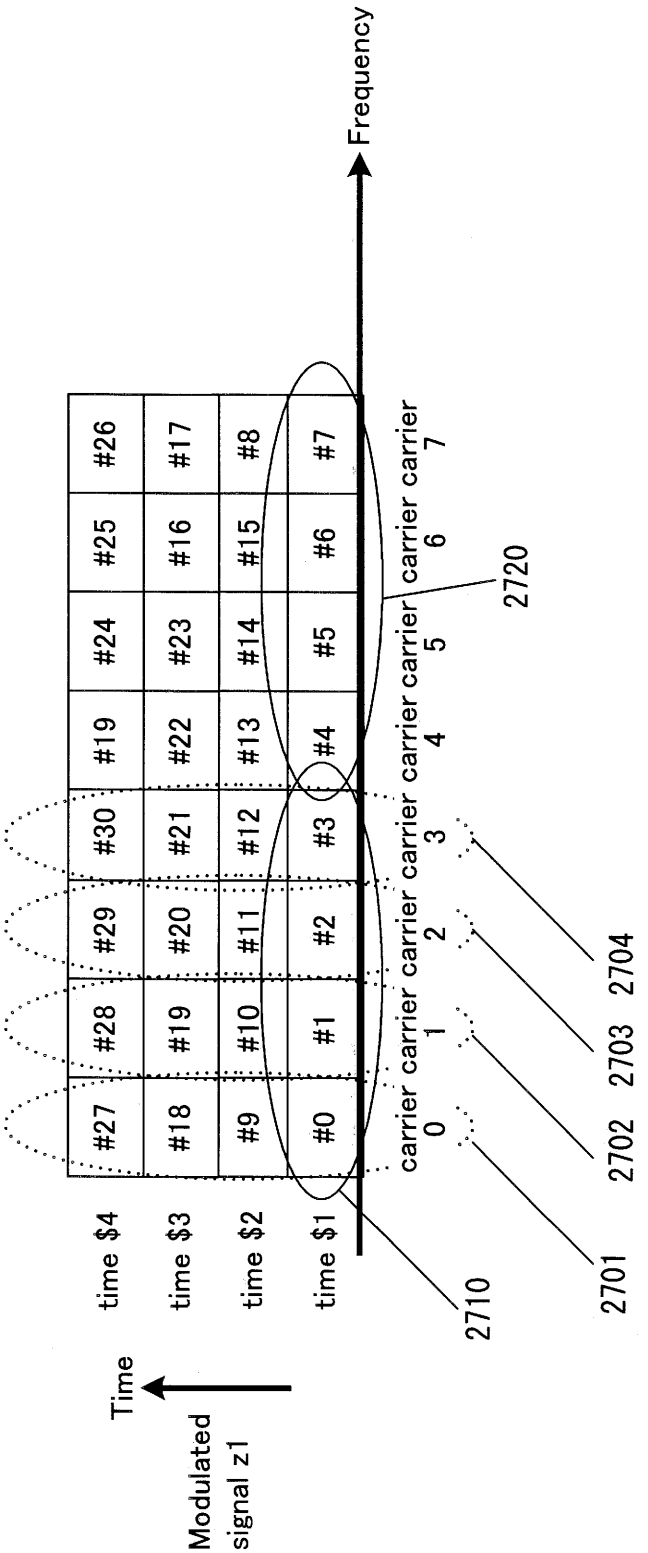

Frequency
carrier 0
carrier 1
carrier 2
carrier 3
carrier 4
carrier 5
carrier 6
carrier 7
2720
time $4
time $3
time $2
time $1
#27
#18
#9
#0
#28
#19
#10
#1
#29
#20
#11
#2
#30
#21
#12
#3
#19
#22
#13
#4
#24
#23
#14
#5
#25
#16
#15
#6
#26
#17
#8
#7
Time
Modulated signal z1
2710
2701
2702
2703
2704

FIG. 28

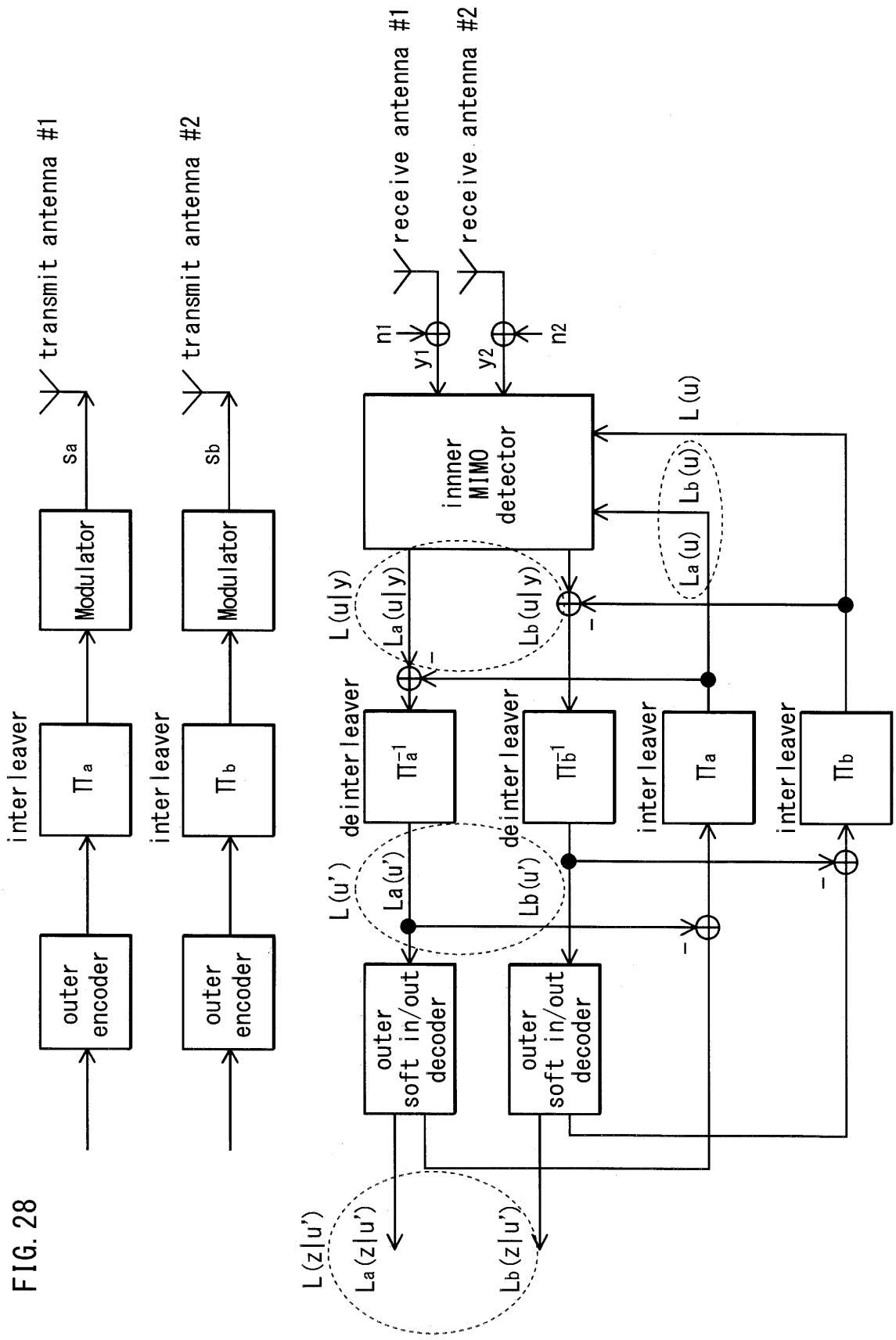

transmit antenna #1
transmit antenna #2
receive antenna #1
receive antenna #2
outer encoder
outer encoder
interleaver
interleaver
Modulator
Modulator
Sa
Sb
n1
n2
y1
y2
innner MIMO detector
L(u)
Lb(u)
La(u)
L(u|y)
La(u|y)
Lb(u|y)
deinterleaver
deinterleaver
interleaver
interleaver
L(u')
La(u')
Lb(u')
outer soft in/out decoder
outer soft in/out decoder
L(z|u')
La(z|u')
Lb(z|u')

FIG. 29B

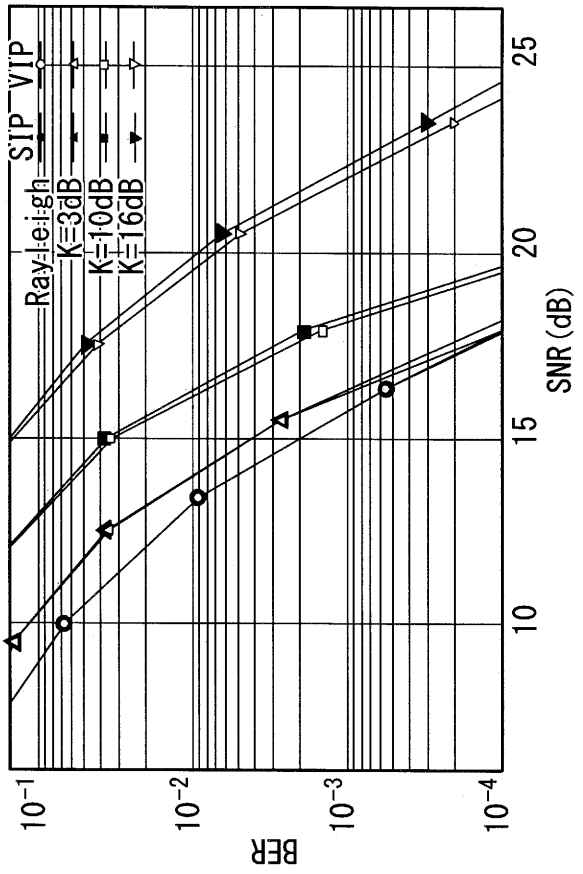


FIG. 29A

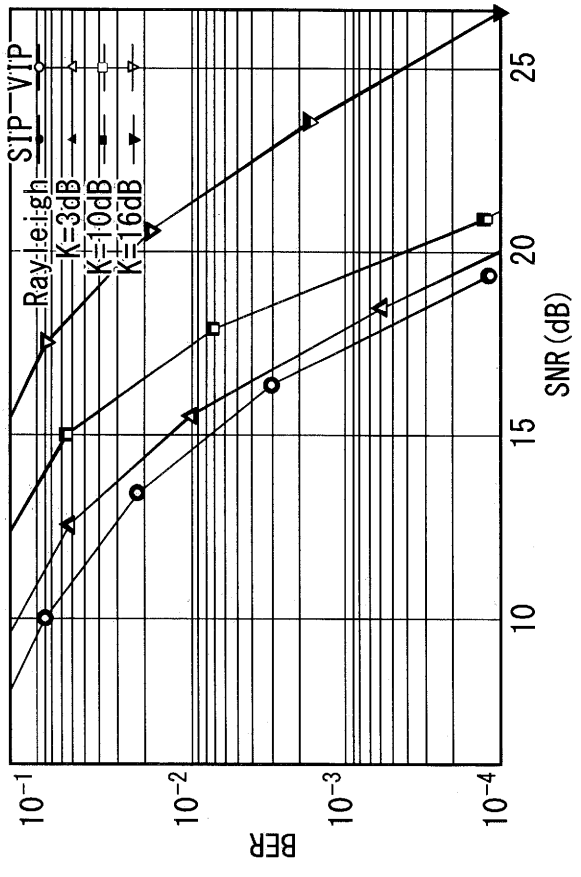


FIG. 30

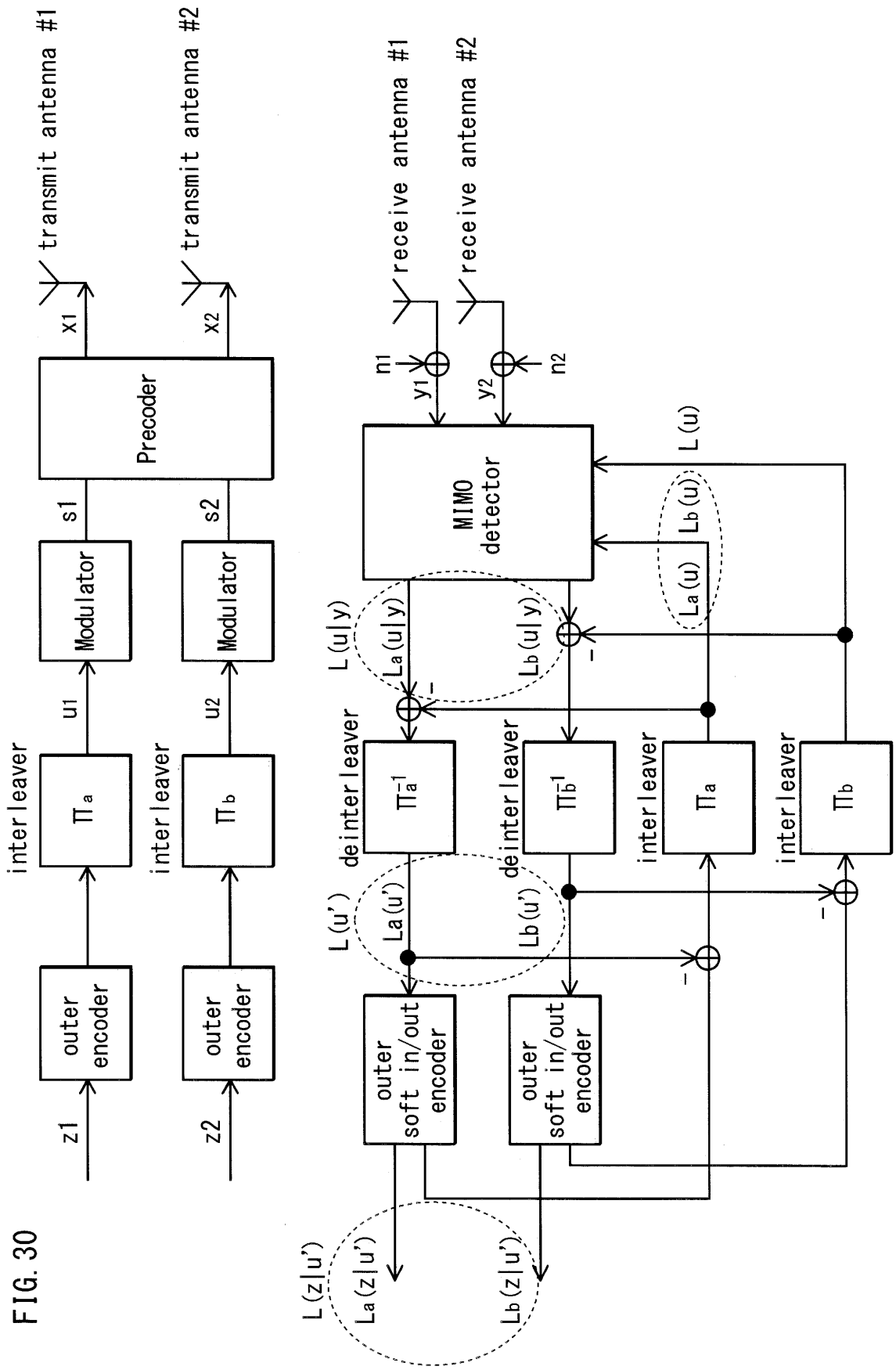

transmit antenna #1
transmit antenna #2
receive antenna #1
receive antenna #2
Precoder
Modulator
Modulator
MIMO detector
outer encoder
outer encoder
outer soft in/out encoder
outer soft in/out encoder
interleaver
interleaver
deinterleaver
deinterleaver
interleaver
interleaver
z1
z2
u1
u2
s1
s2
x1
x2
n1
n2
y1
y2
L(u)
L(u|y)
L(u')
L(z|u')
La(u)
Lb(u)
La(u|y)
Lb(u|y)
La(u')
Lb(u')
La(z|u')
Lb(z|u')

FIG. 31A

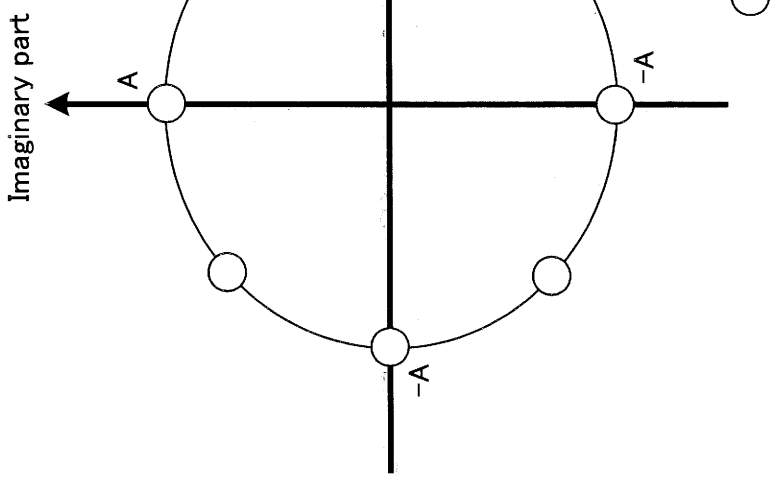


FIG. 31B

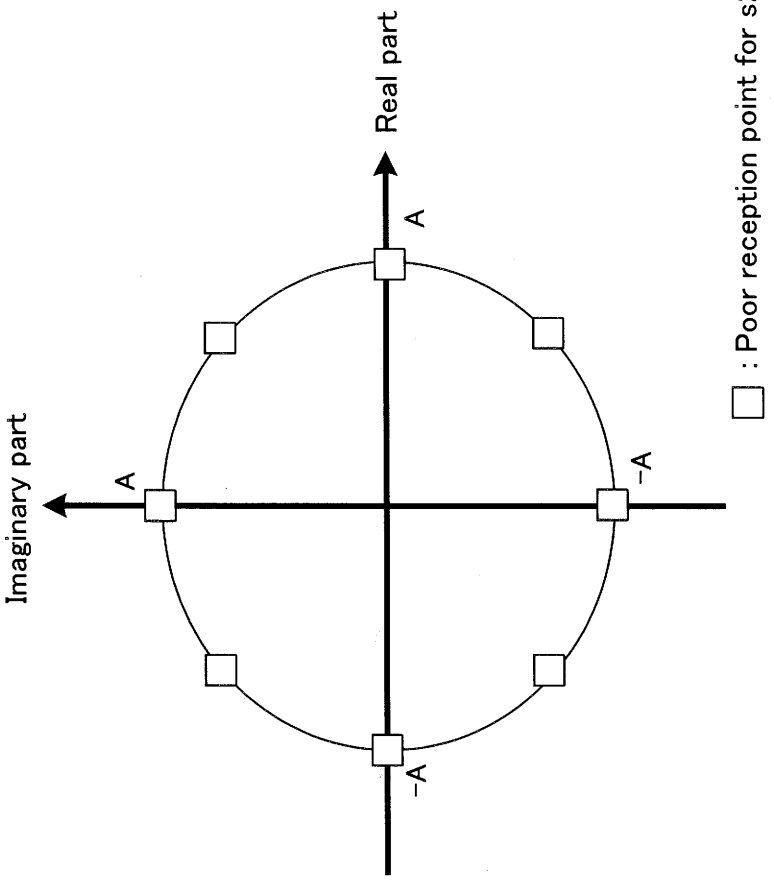


FIG. 32

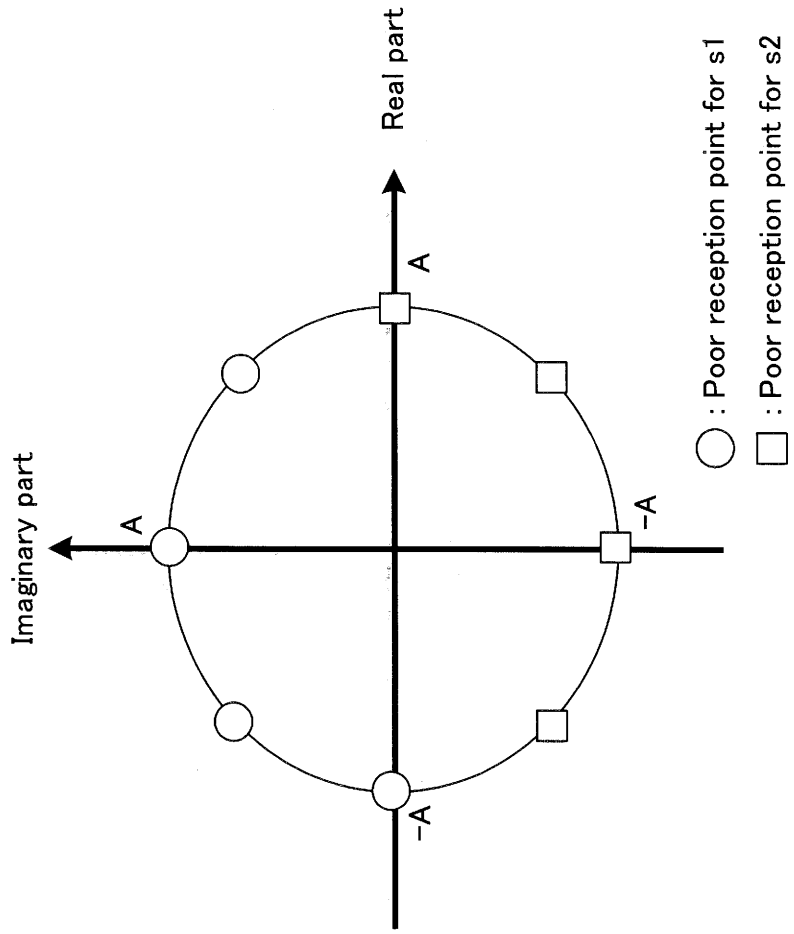

Real part
Imaginary part
A
-A
A
-A
○ : Poor reception point for s1
□ : Poor reception point for s2

FIG. 33A

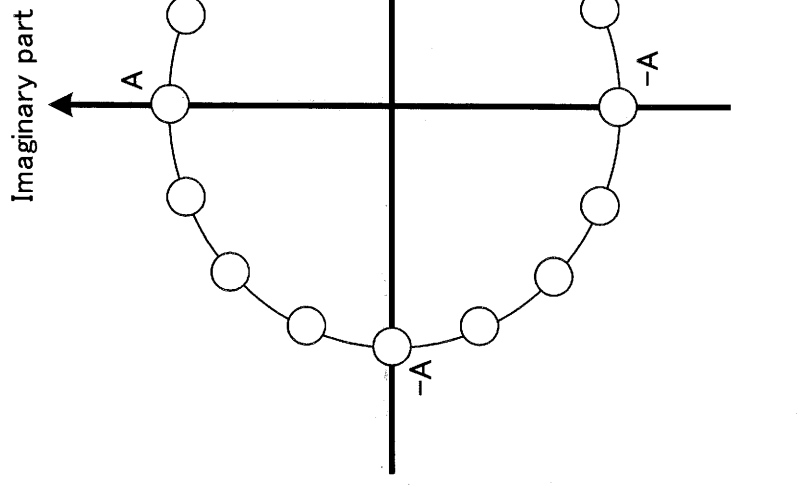


FIG. 33B

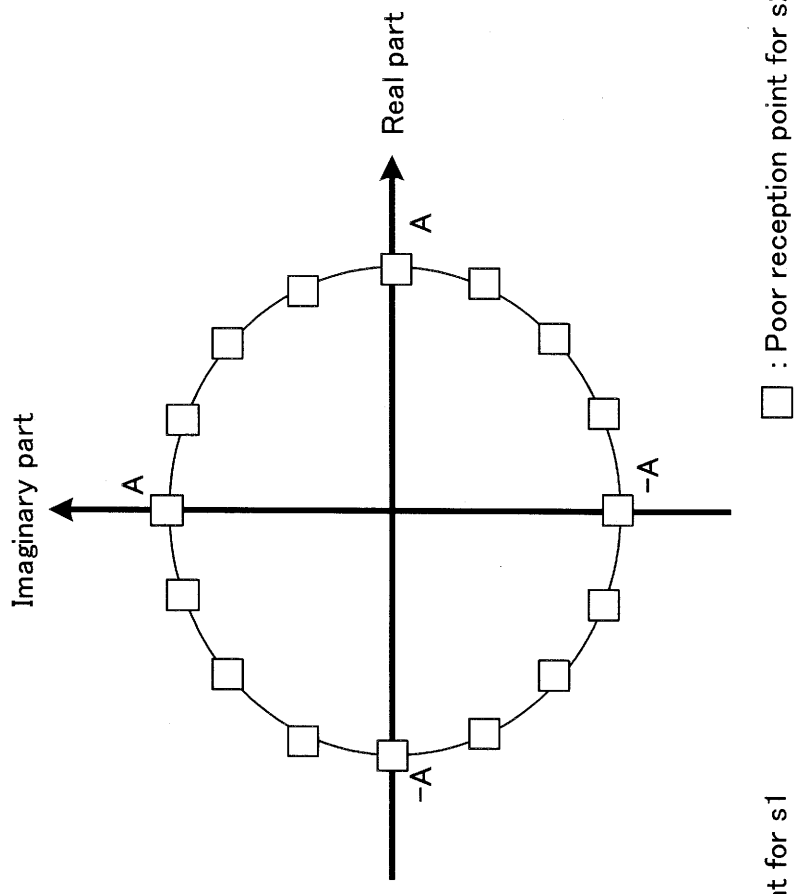


FIG. 34

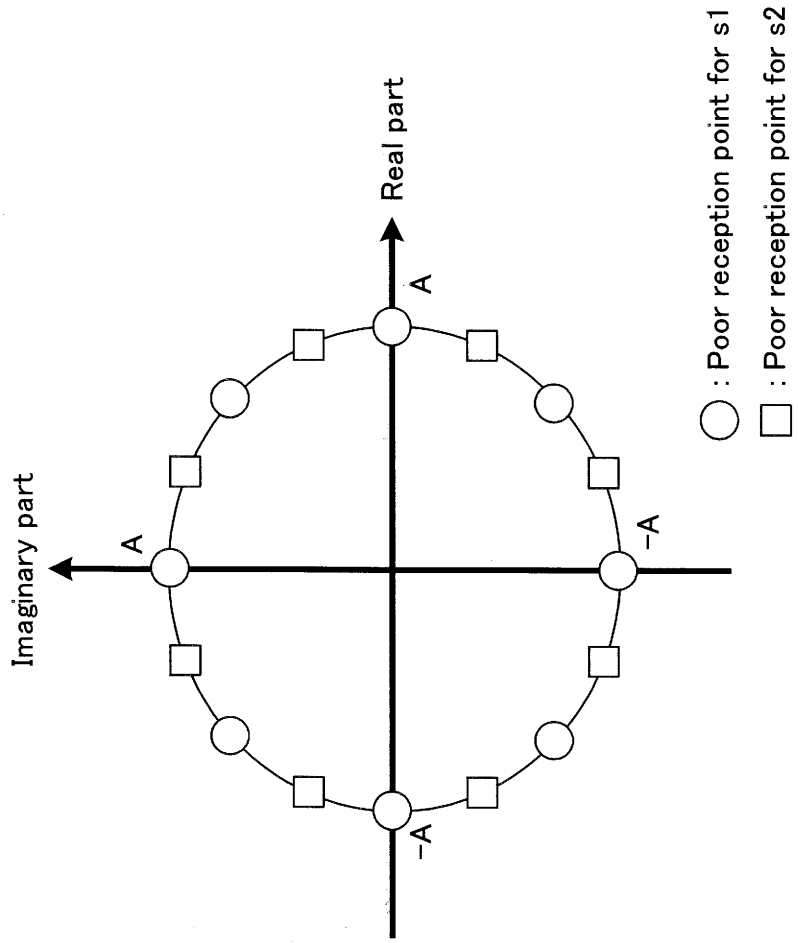
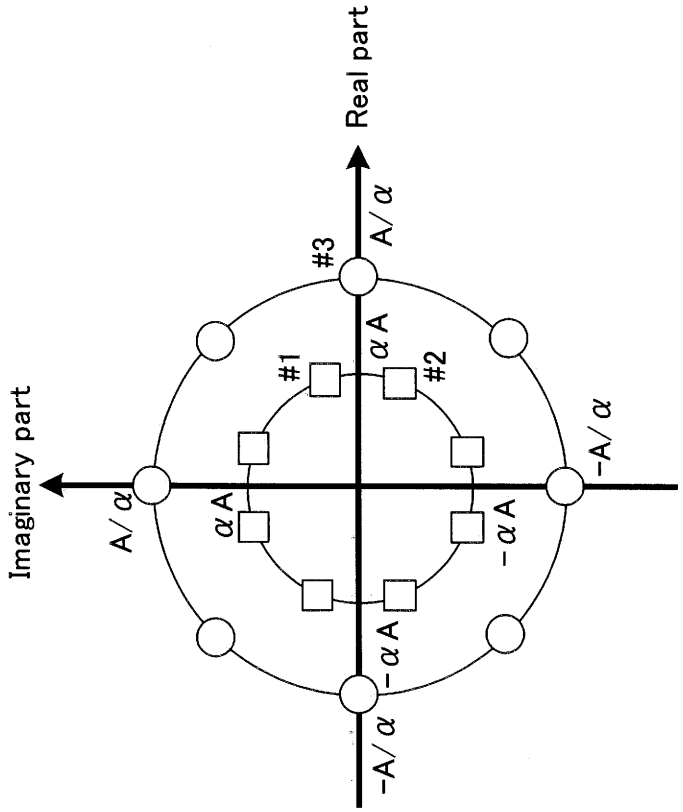
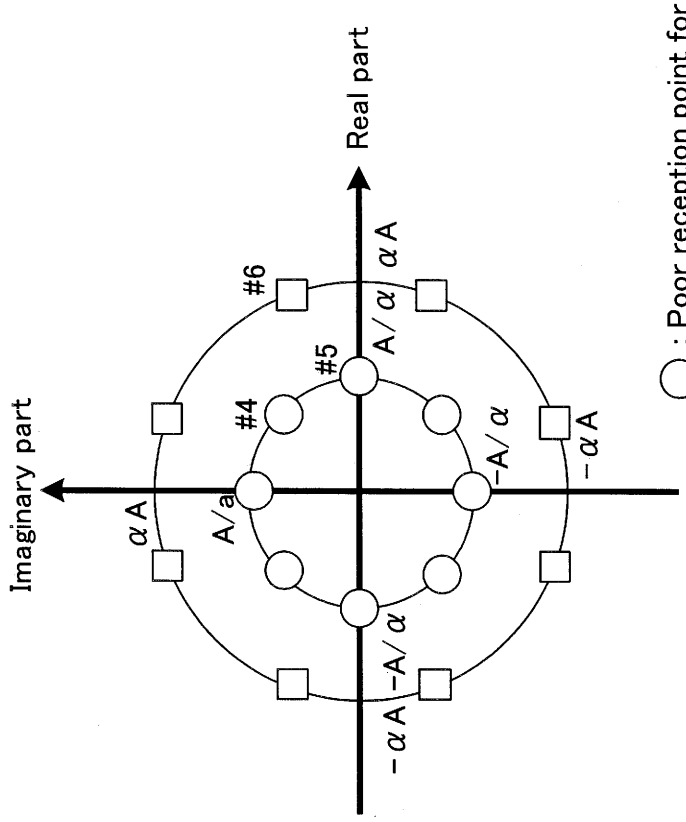

Real part
Imaginary part
A
-A
A
-A
○ : Poor reception point for s1
□ : Poor reception point for s2

FIG. 35A



α<1

FIG. 35B



α>1

○ : Poor reception point for s1

□ : Poor reception point for s2

FIG. 36

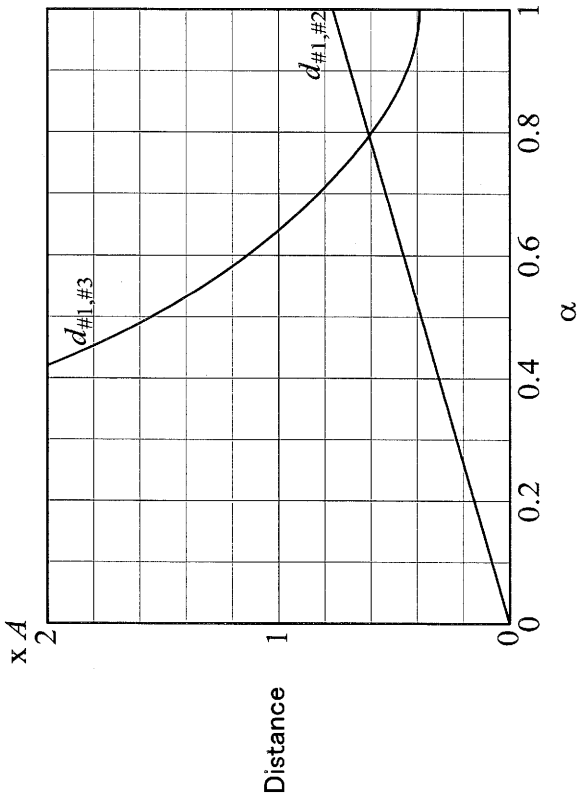


FIG. 37

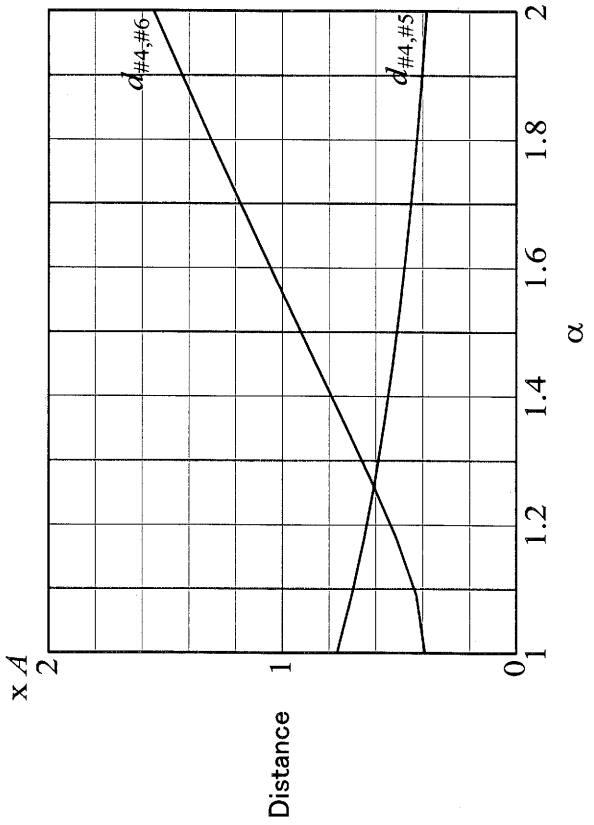


FIG. 38A

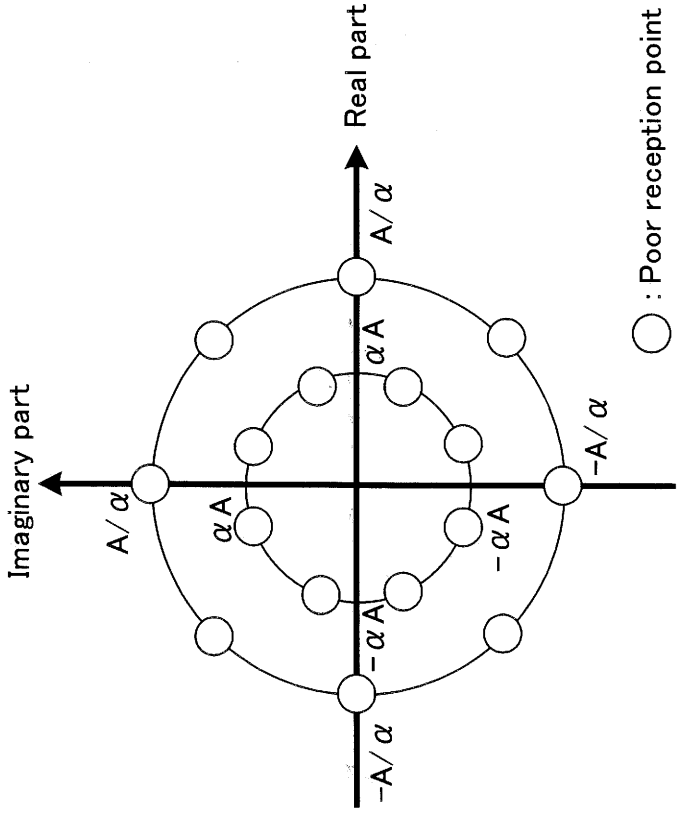


FIG. 38B

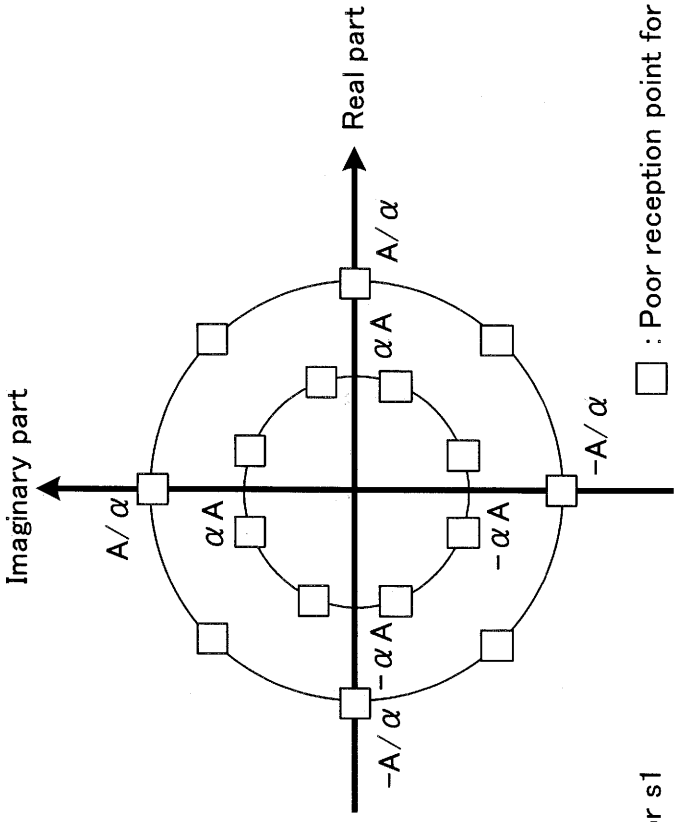


FIG. 39A

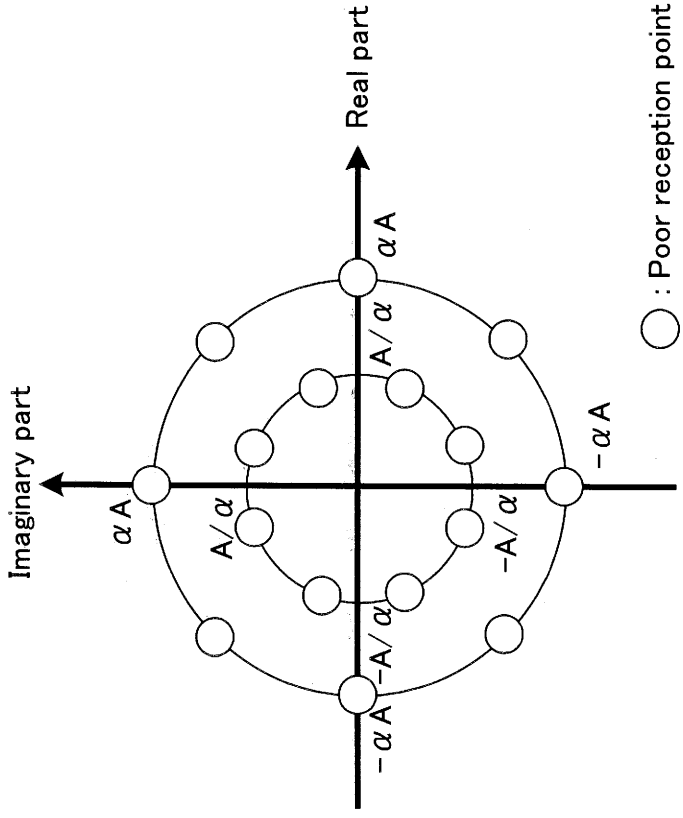


FIG. 39B

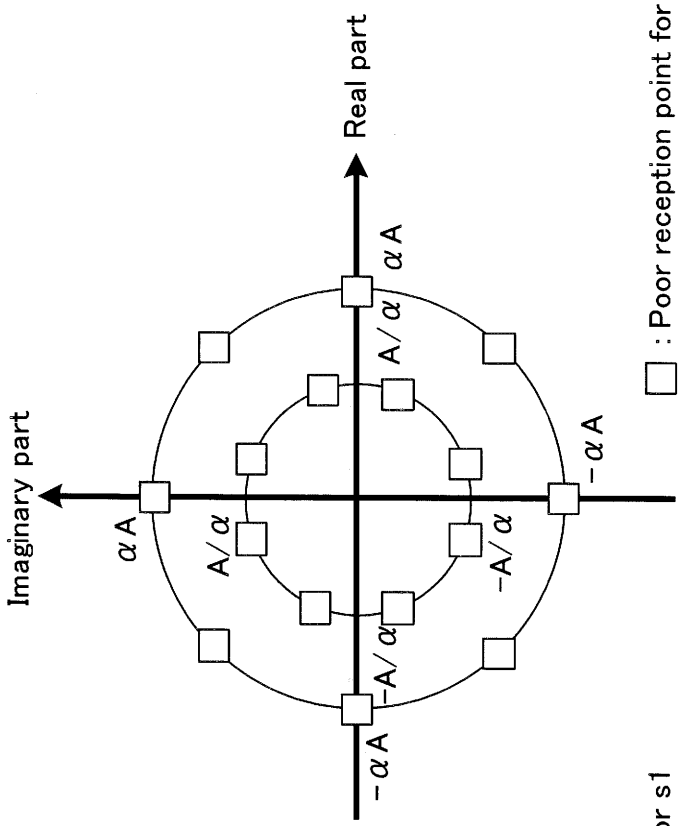


FIG. 40

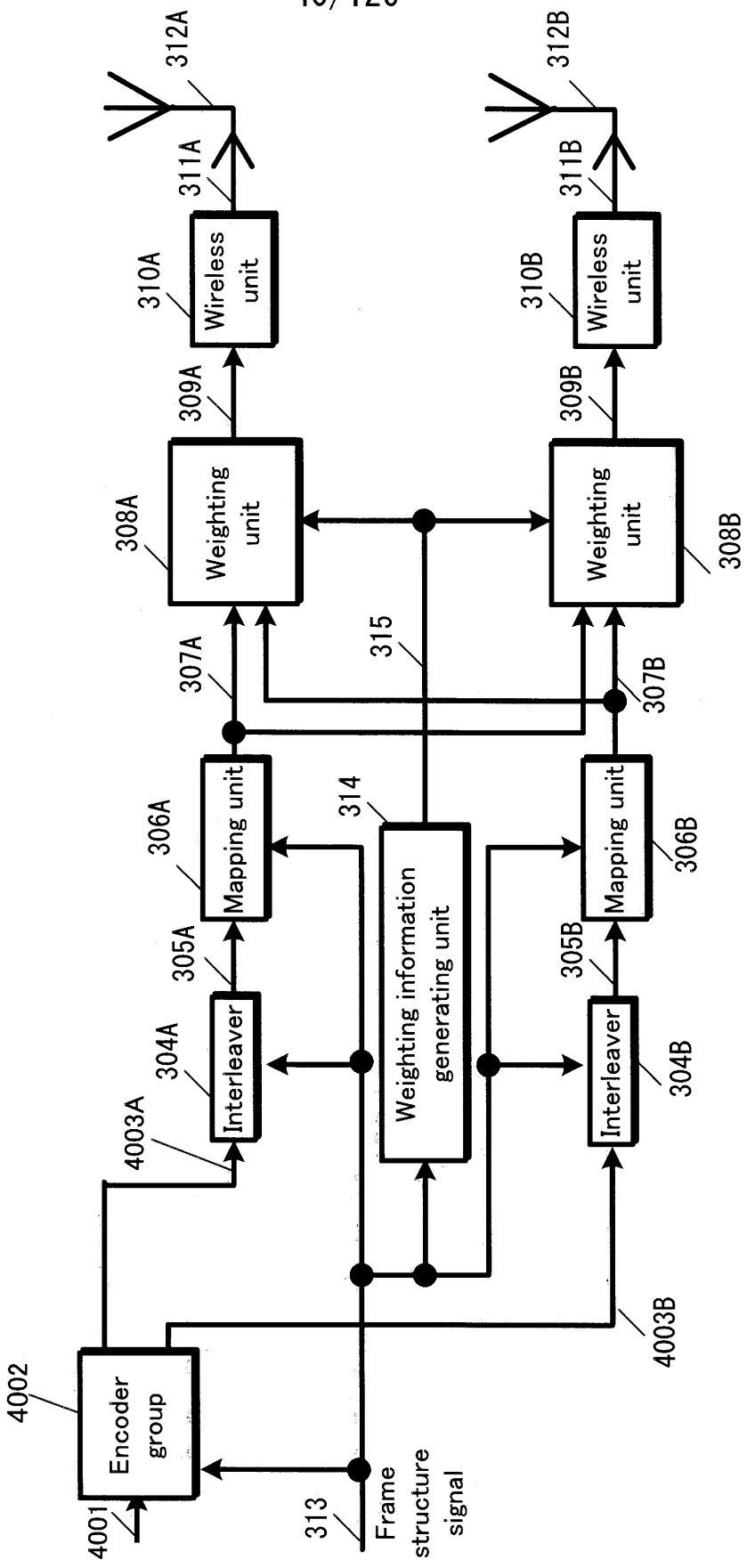

4001
4002
Encoder group
313
Frame structure signal
4003A
4003B
304A
Interleaver
305A
306A
Mapping unit
307A
308A
Weighting unit
309A
310A
Wireless unit
311A
312A
304B
Interleaver
305B
306B
Mapping unit
307B
308B
Weighting unit
309B
310B
Wireless unit
311B
312B
314
Weighting information generating unit
315

FIG. 41

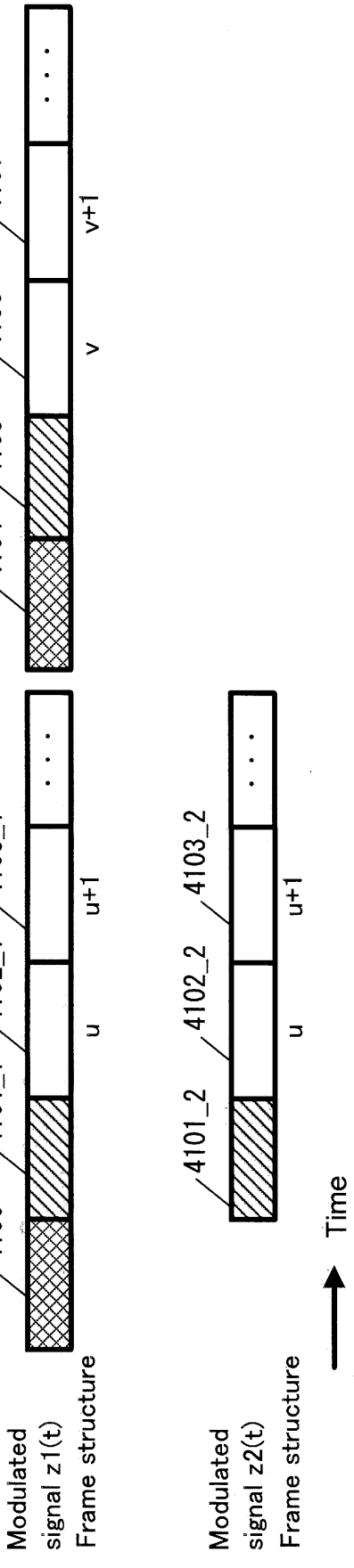

4100
4101_1
4102_1
4103_1
4104
4105
4106
4107
u
u+1
v
v+1
Modulated signal z1(t) Frame structure
4101_2
4102_2
4103_2
Modulated signal z2(t) Frame structure
Time

FIG. 42A

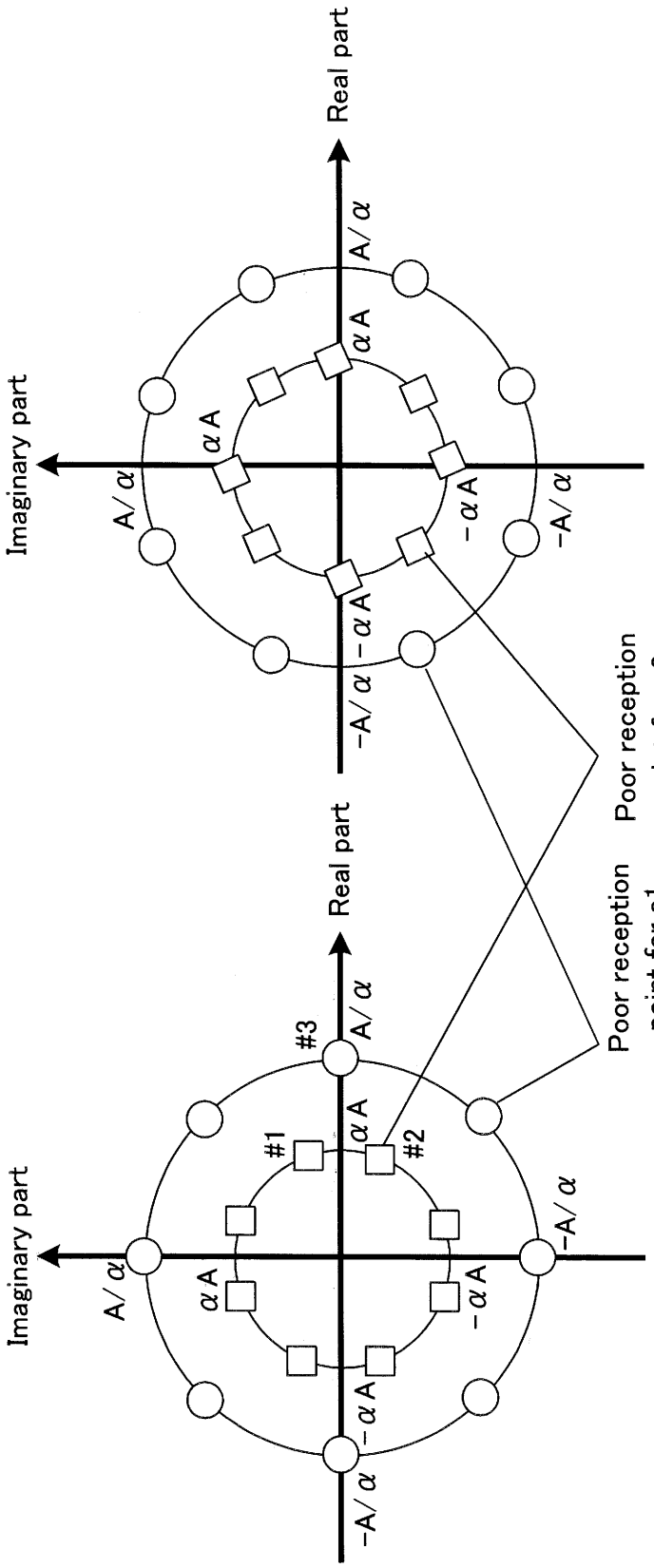


FIG. 42B

FIG. 43A

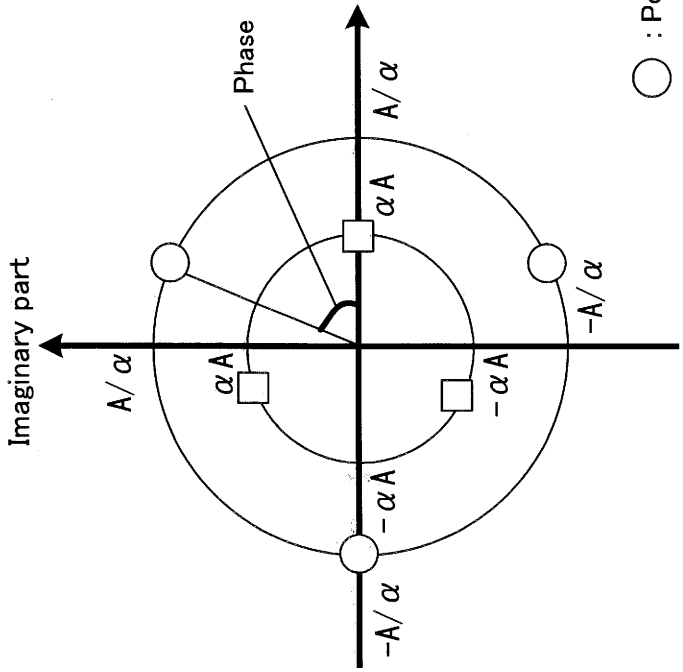


FIG. 43B

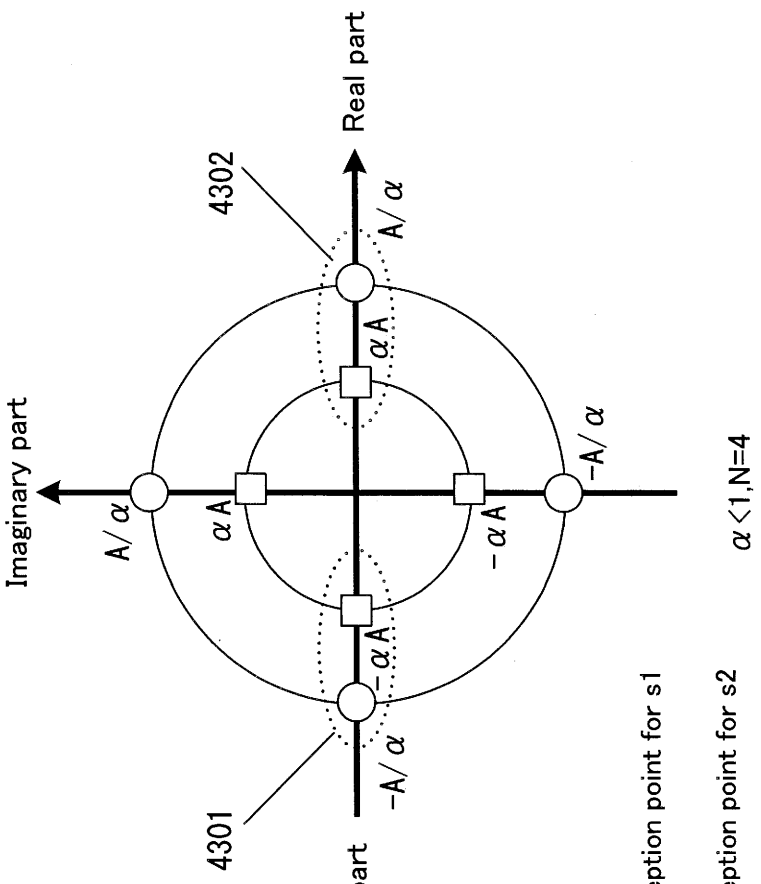
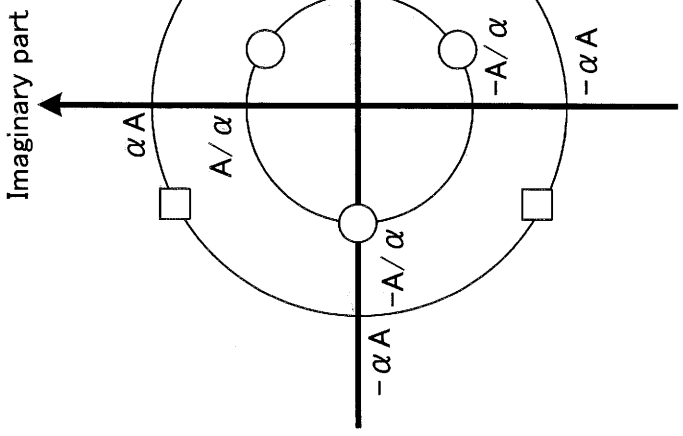
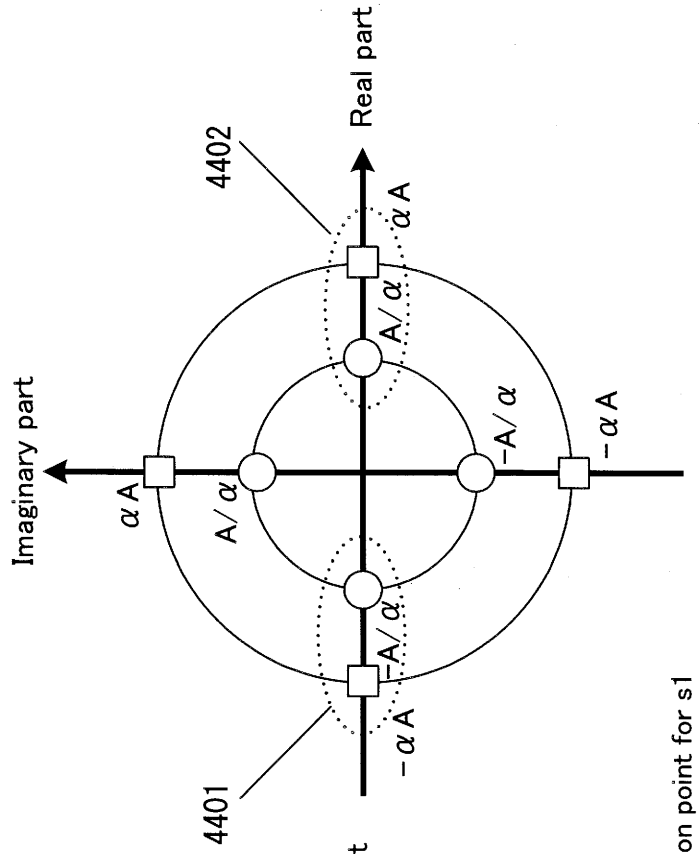


FIG. 44A



α>1,N=3

FIG. 44B



α>1,N=4

FIG. 45A

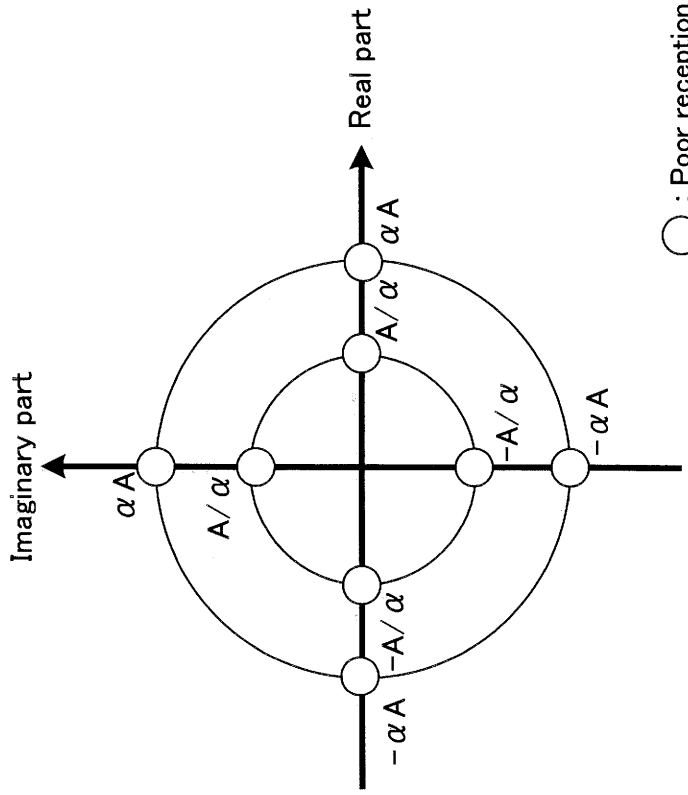
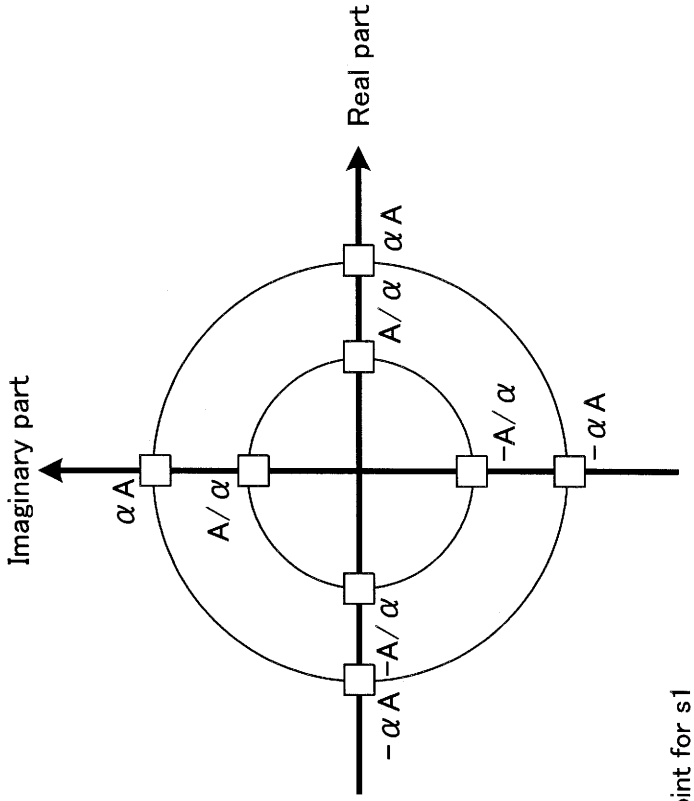


FIG. 45B



○ : Poor reception point for s1

□ : Poor reception point for s2

FIG. 46A

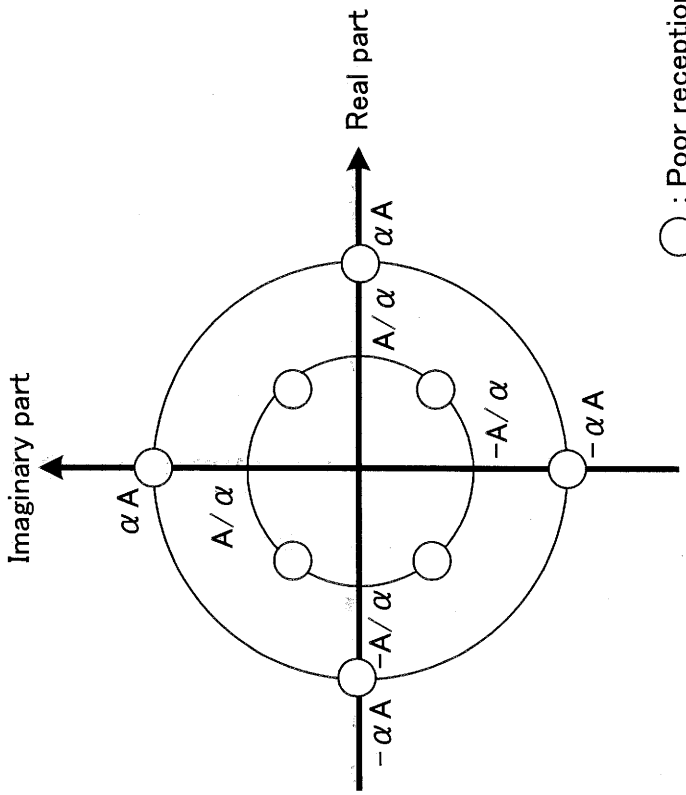


FIG. 46B

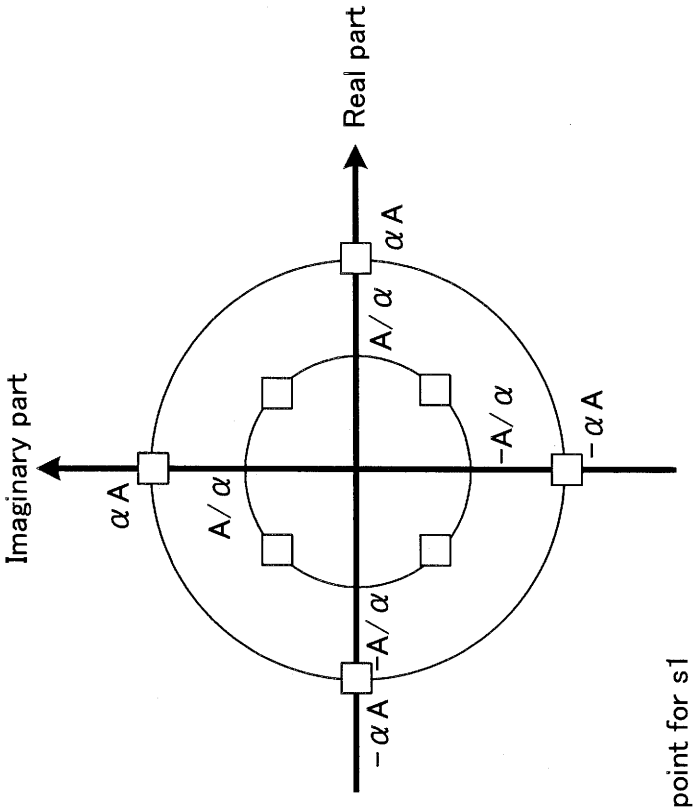


FIG. 47A

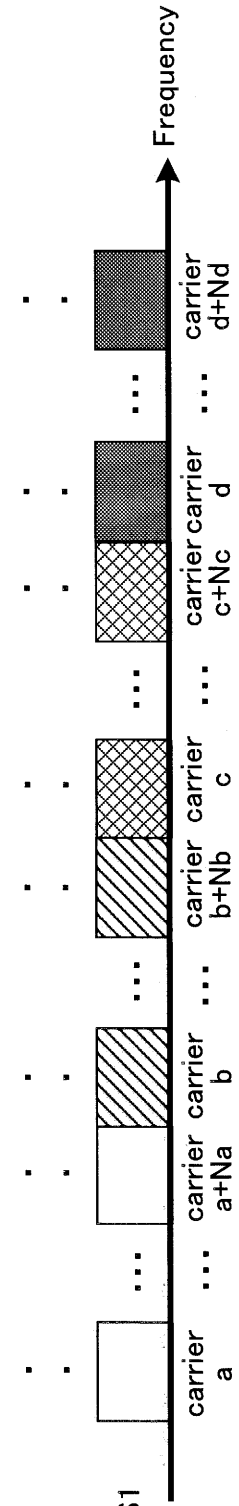


FIG. 47B

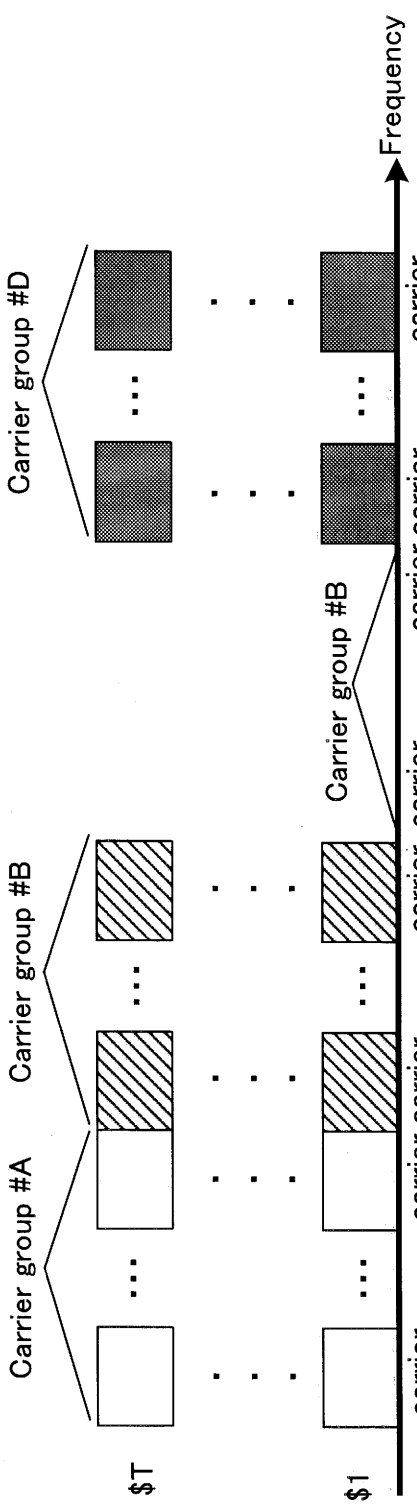


FIG. 48A

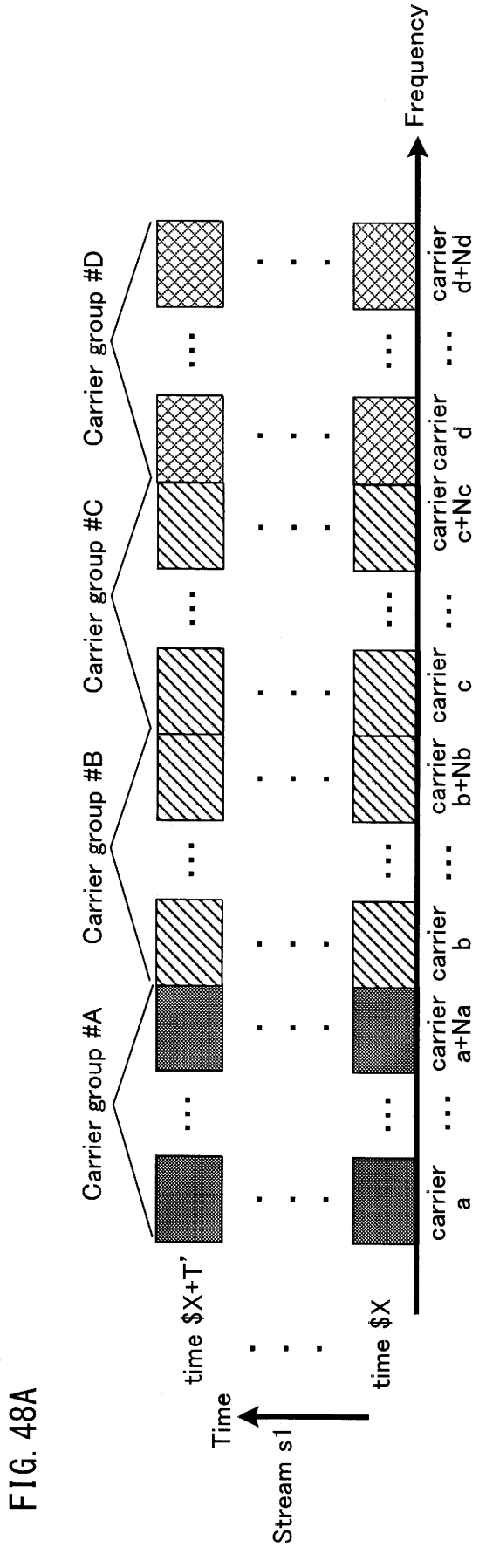


FIG. 48B

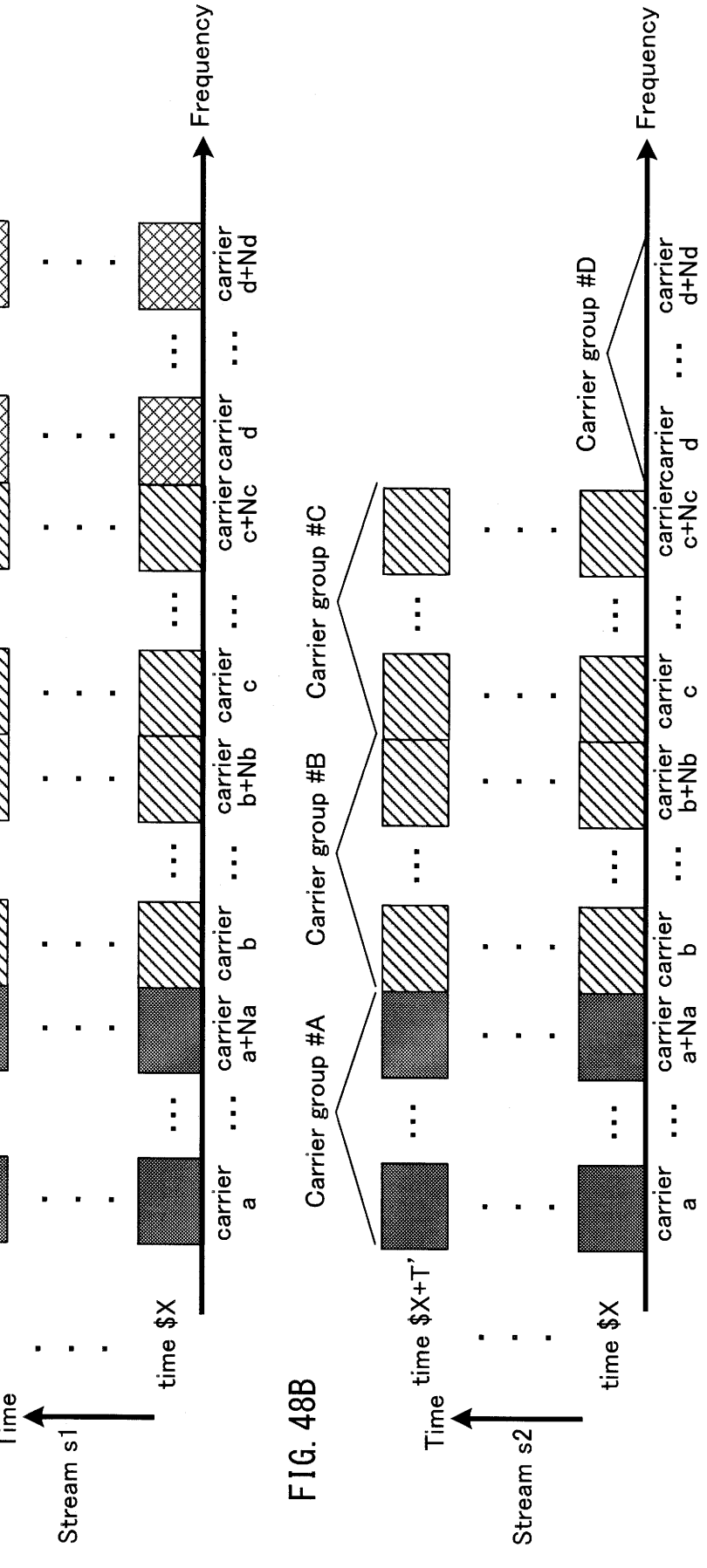
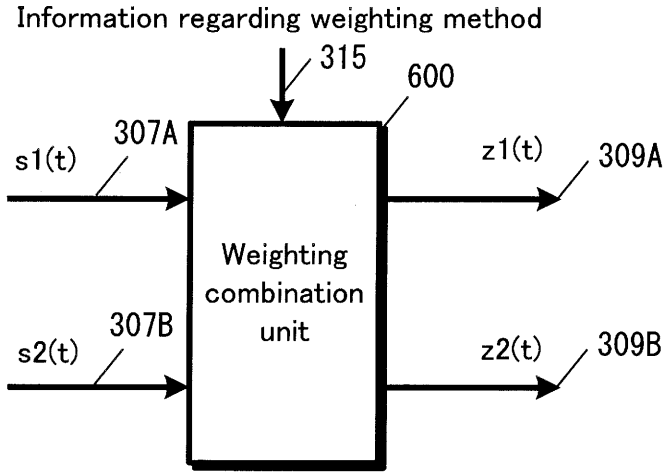


FIG. 49



Method #1:

$$\begin{pmatrix} z1(t) \\ z2(t) \end{pmatrix} = \begin{pmatrix} e^{j0} & 0 \\ 0 & e^{j0} \end{pmatrix} \begin{pmatrix} s1(t) \\ s2(t) \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} s1(t) \\ s2(t) \end{pmatrix}$$

Different expression

$$\begin{pmatrix} z1(t) \\ z2(t) \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} e^{j0} & 0 \\ 0 & e^{j0} \end{pmatrix} \begin{pmatrix} s1(t) \\ s2(t) \end{pmatrix}$$

$$= \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} s1(t) \\ s2(t) \end{pmatrix}$$

Method #2:

$$\begin{pmatrix} z1(t) \\ z2(t) \end{pmatrix} = \frac{1}{\sqrt{\alpha^2 + 1}} \begin{pmatrix} e^{j\theta_{11}(i)} & \alpha \times e^{j(\theta_{11}(i)+\lambda)} \\ \alpha \times e^{j\theta_{21}(i)} & e^{j(\theta_{21}(i)+\lambda+\delta)} \end{pmatrix} \begin{pmatrix} s1(t) \\ s2(t) \end{pmatrix}$$

FIG. 50

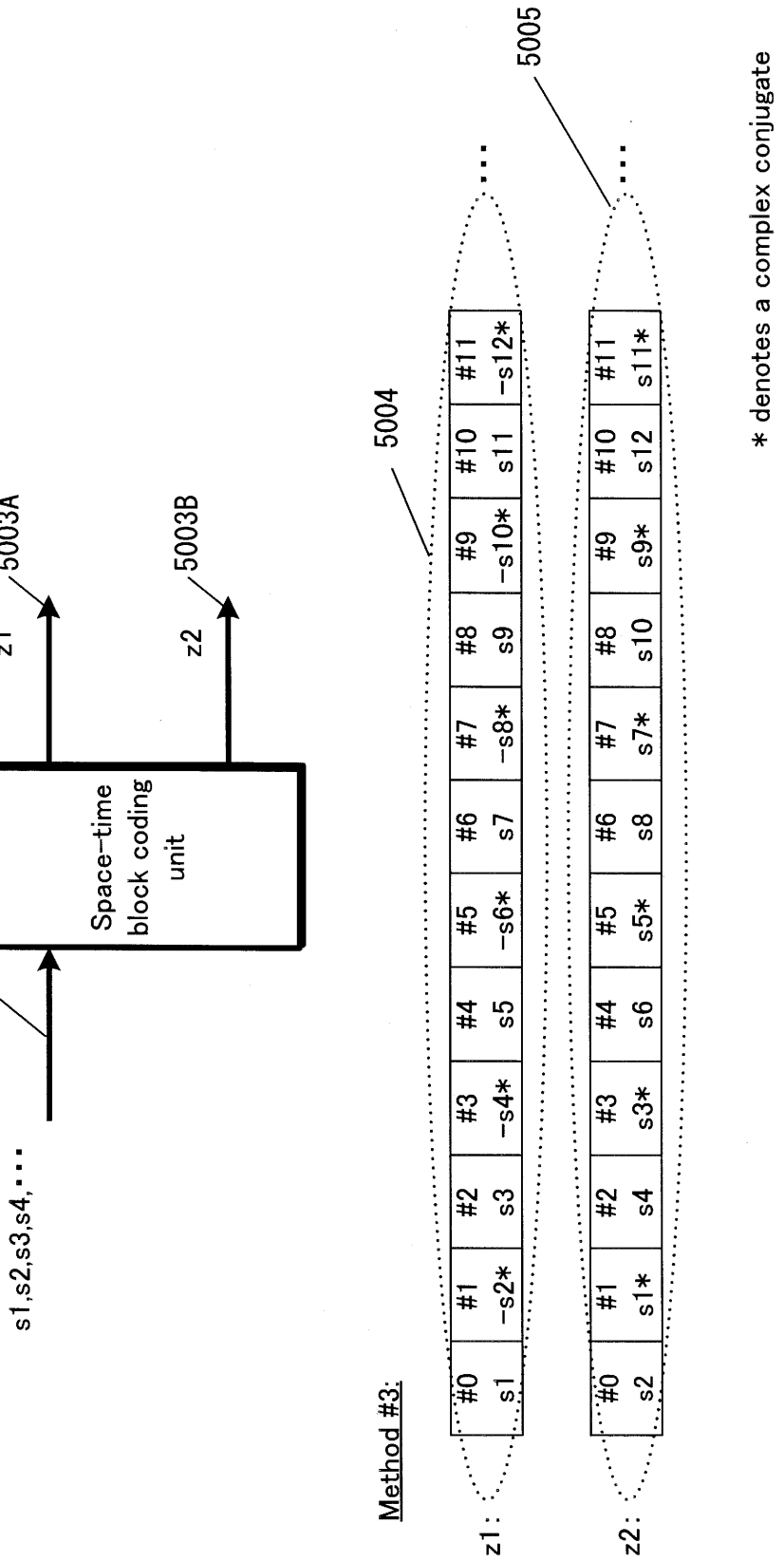

5001
s1,s2,s3,s4,...
5002
Space-time block coding unit
5003A
z1
5003B
z2
5004
5005
Method #3:
z1:
z2:
#0 s1
#1 −s2*
#2 s3
#3 −s4*
#4 s5
#5 −s6*
#6 s7
#7 −s8*
#8 s9
#9 −s10*
#10 s11
#11 −s12*
#0 s2
#1 s1*
#2 s4
#3 s3*
#4 s6
#5 s5*
#6 s8
#7 s7*
#8 s10
#9 s9*
#10 s12
#11 s11*
* denotes a complex conjugate

FIG. 51

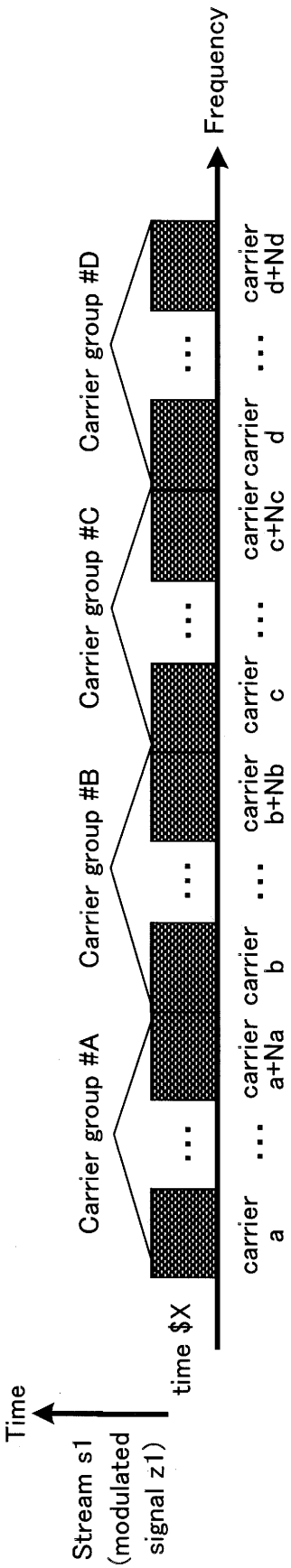

Time
Stream s1
(modulated
signal z1)
time $X
Frequency
Carrier group #A
Carrier group #B
Carrier group #C
Carrier group #D
carrier a
carrier a+Na
carrier b
carrier b+Nb
carrier c
carrier c+Nc
carrier d
carrier d+Nd

FIG. 52

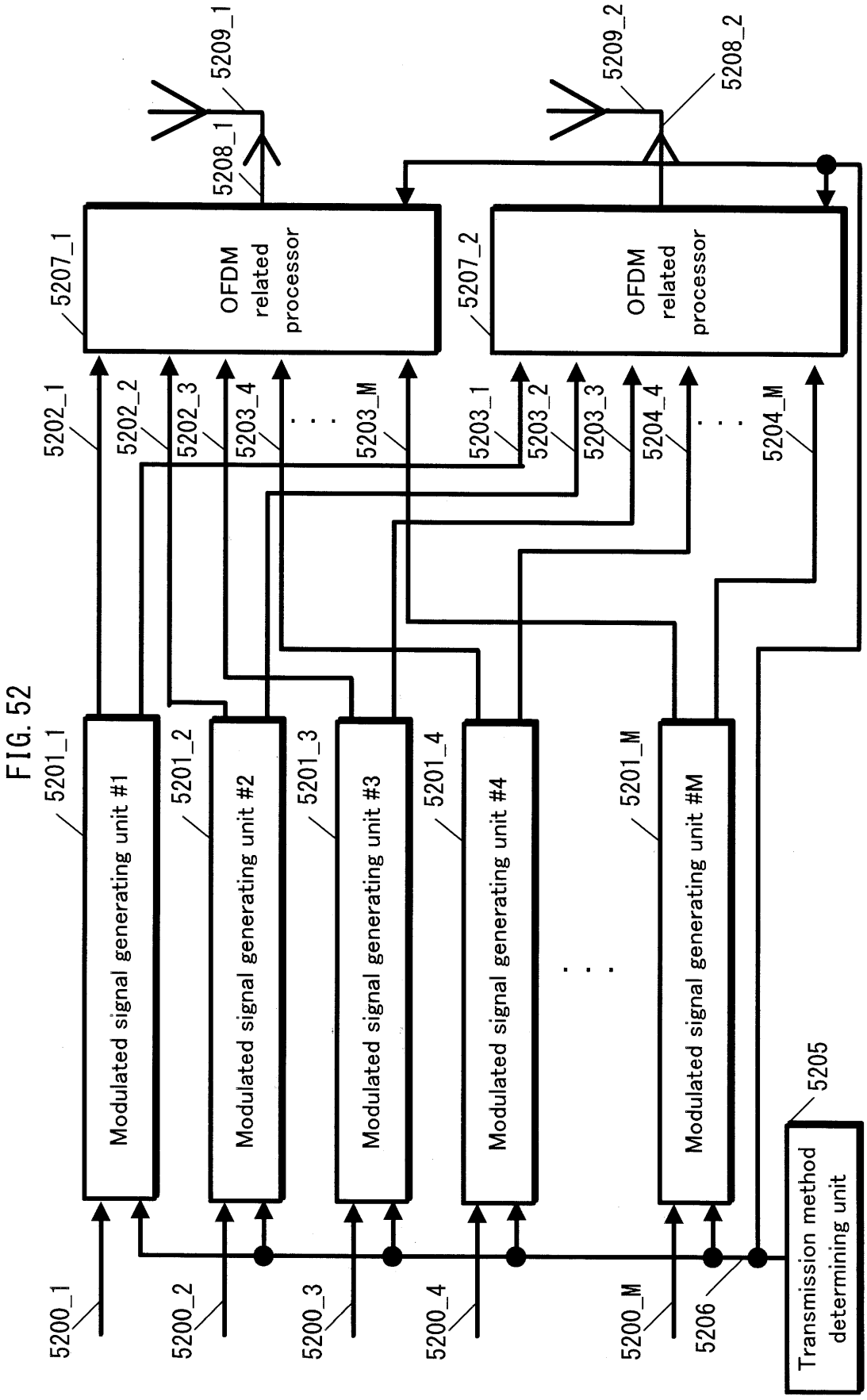
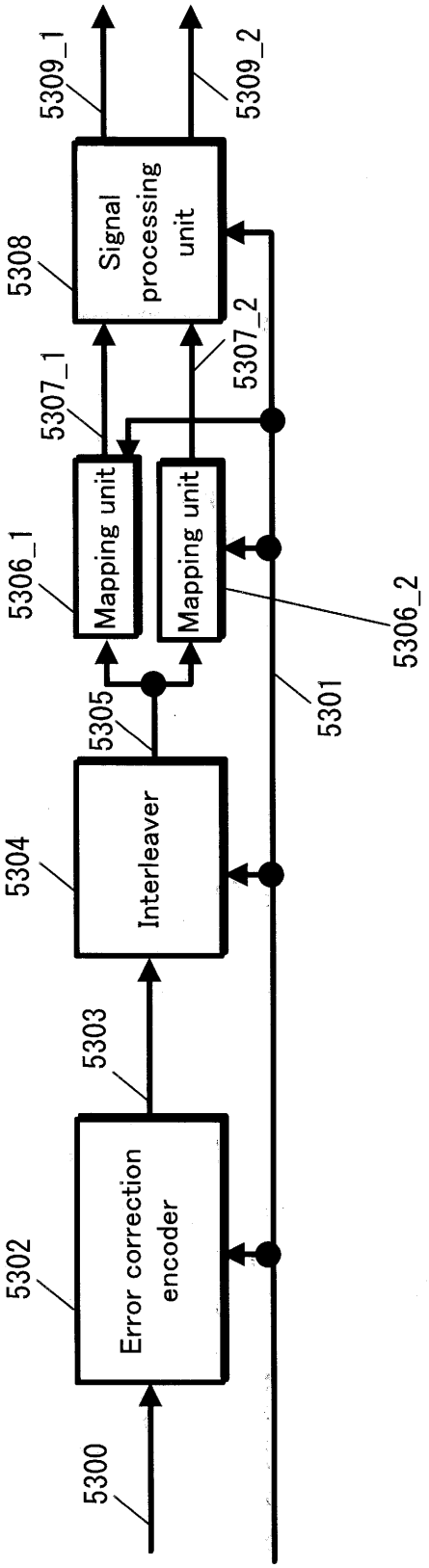

5200_1
5200_2
5200_3
5200_4
5200_M
5201_1
5201_2
5201_3
5201_4
5201_M
Modulated signal generating unit #1
Modulated signal generating unit #2
Modulated signal generating unit #3
Modulated signal generating unit #4
Modulated signal generating unit #M
5202_1
5202_2
5202_3
5203_4
5203_M
5203_1
5203_2
5203_3
5204_4
5204_M
5205
Transmission method determining unit
5206
5207_1
5207_2
OFDM related processor
OFDM related processor
5208_1
5208_2
5209_1
5209_2

FIG. 53


5309_1
5309_2
5308
Signal processing unit
5307_2
5307_1
Mapping unit
Mapping unit
5306_1
5306_2
5305
5301
5304
Interleaver
5303
Error correction encoder
5302
5300

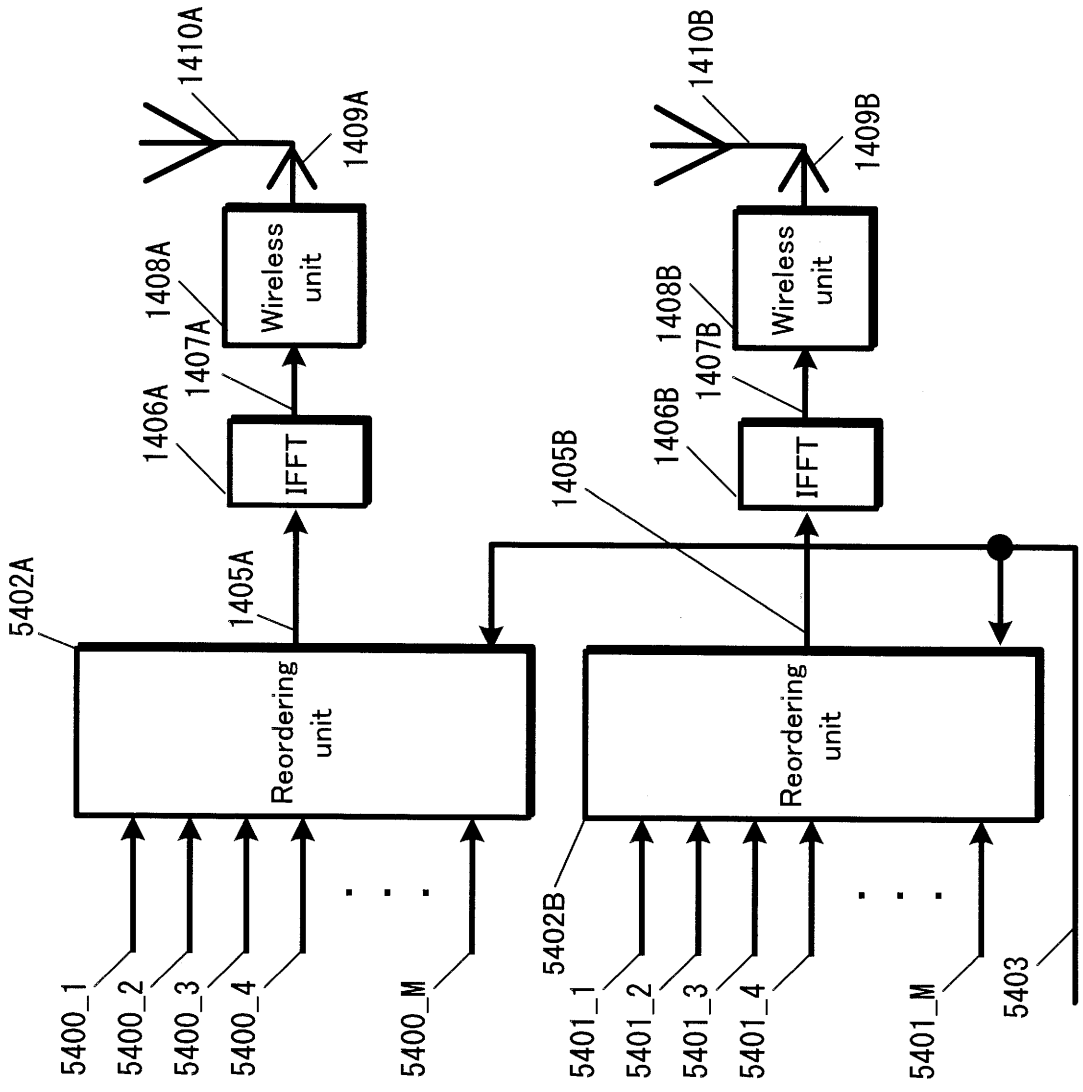

5400_1
5400_2
5400_3
5400_4
5400_M
5401_1
5401_2
5401_3
5401_4
5401_M
5403
5402A
5402B
Reordering unit
Reordering unit
1405A
1405B
1406A
1406B
IFFT
IFFT
1407A
1407B
1408A
1408B
Wireless unit
Wireless unit
1409A
1409B
1410A
1410B

FIG. 54

FIG. 55A

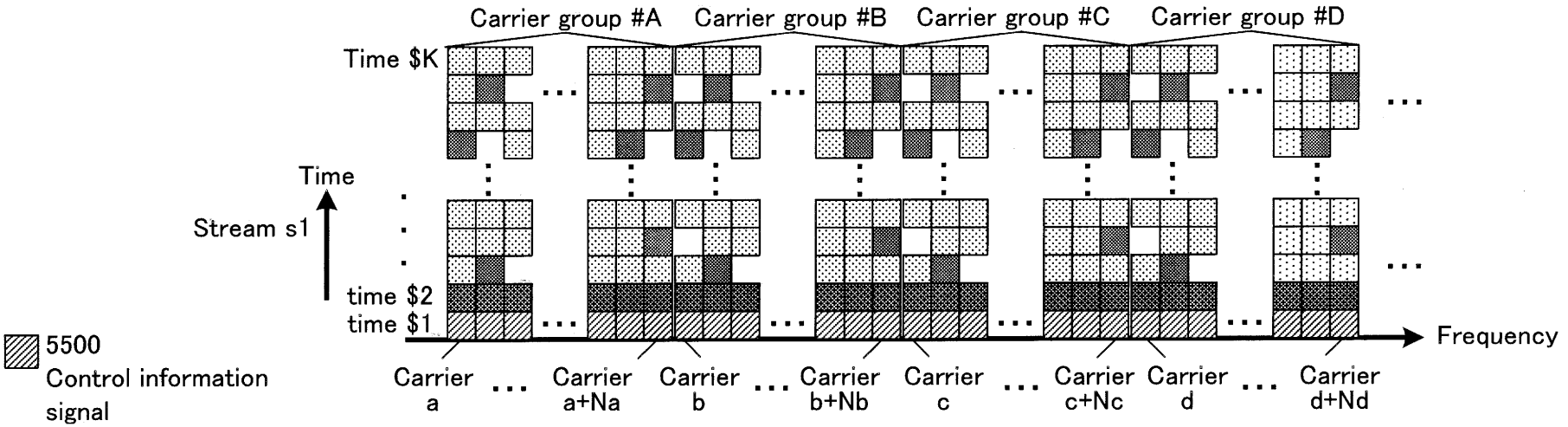


FIG. 55B

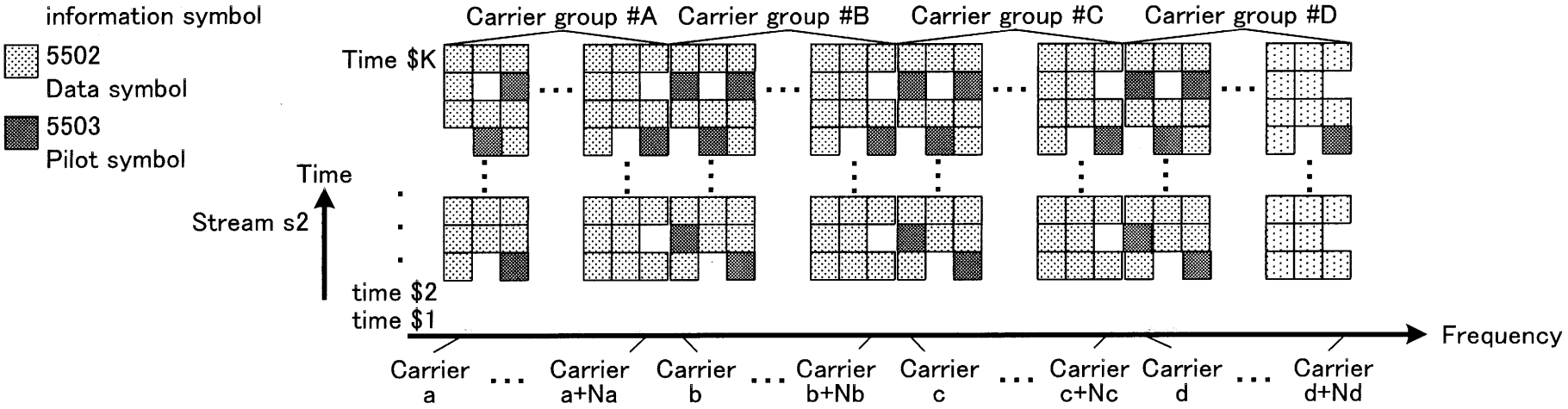


FIG. 56

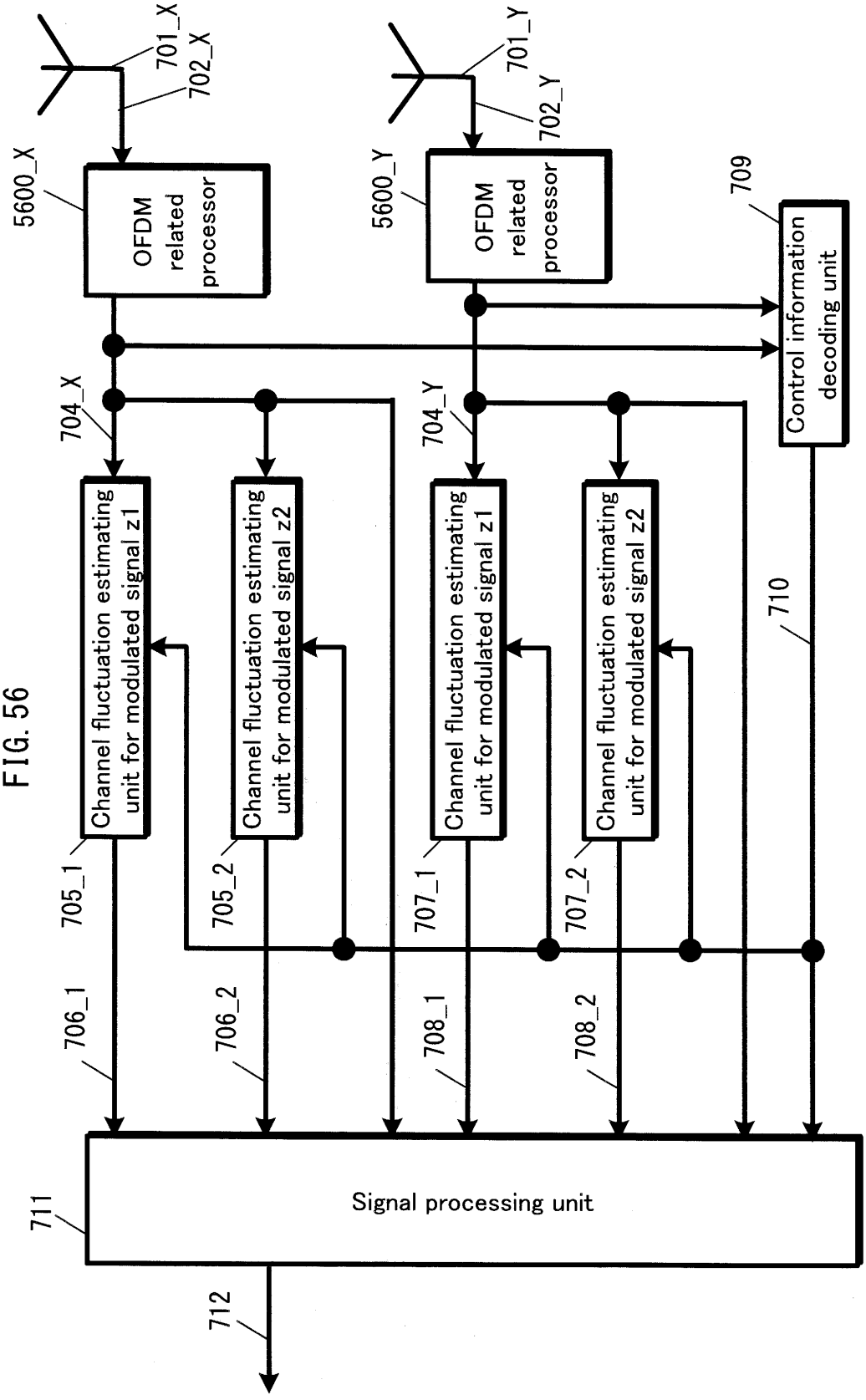

701_X
702_X
701_Y
702_Y
5600_X
OFDM related processor
5600_Y
OFDM related processor
709
Control information decoding unit
704_X
704_Y
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
710
705_1
705_2
707_1
707_2
706_1
706_2
708_1
708_2
711
Signal processing unit
712

FIG. 57

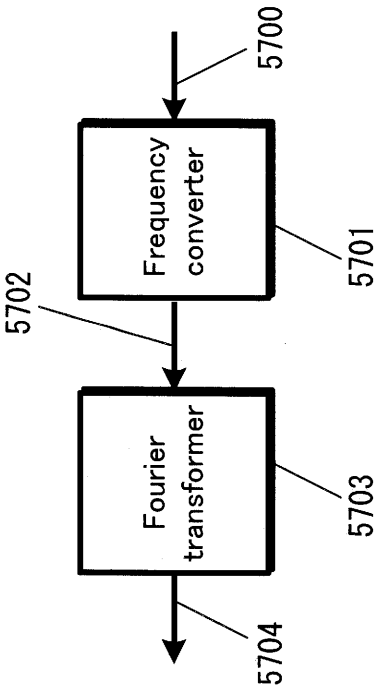

5700
Frequency converter
5701
5702
Fourier transformer
5703
5704

FIG. 58A

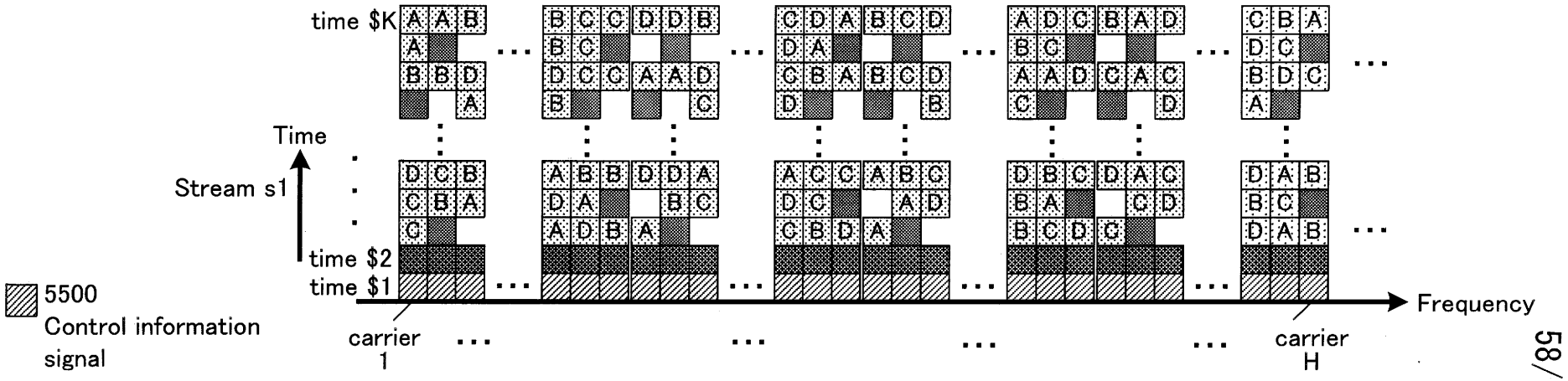


FIG. 58B

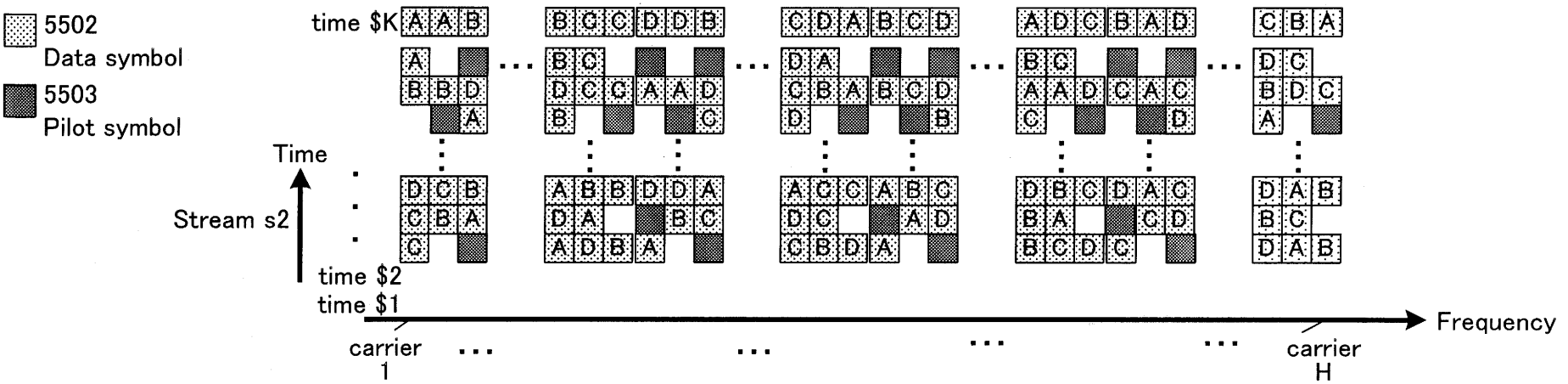


FIG. 59

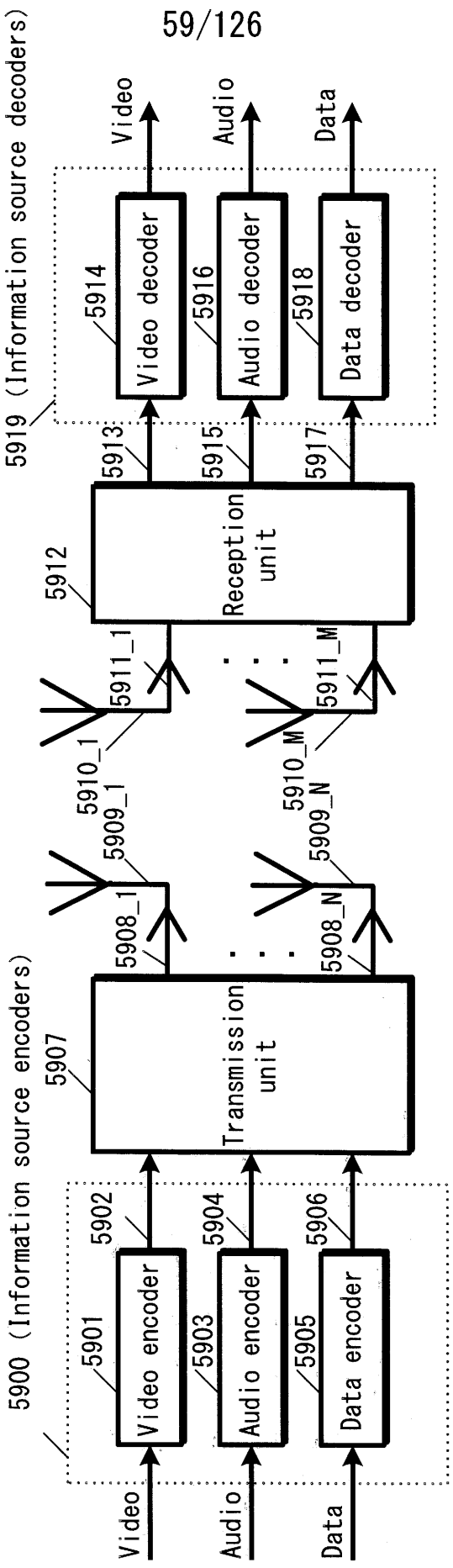

5900 (Information source encoders)
Video
Audio
Data
5901
Video encoder
5902
5903
Audio encoder
5904
5905
Data encoder
5906
5907
Transmission unit
5908_1
5908_N
5909_1
5909_N
5910_1
5910_M
5911_1
5911_M
5912
Reception unit
5913
5915
5917
5919 (Information source decoders)
5914
Video decoder
5916
Audio decoder
5918
Data decoder
Video
Audio
Data

FIG. 60A

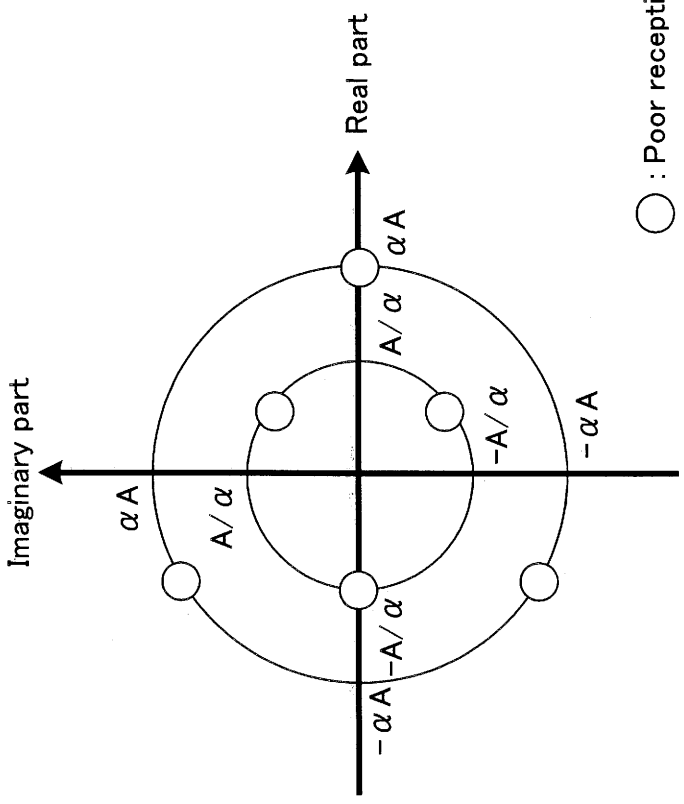


FIG. 60B

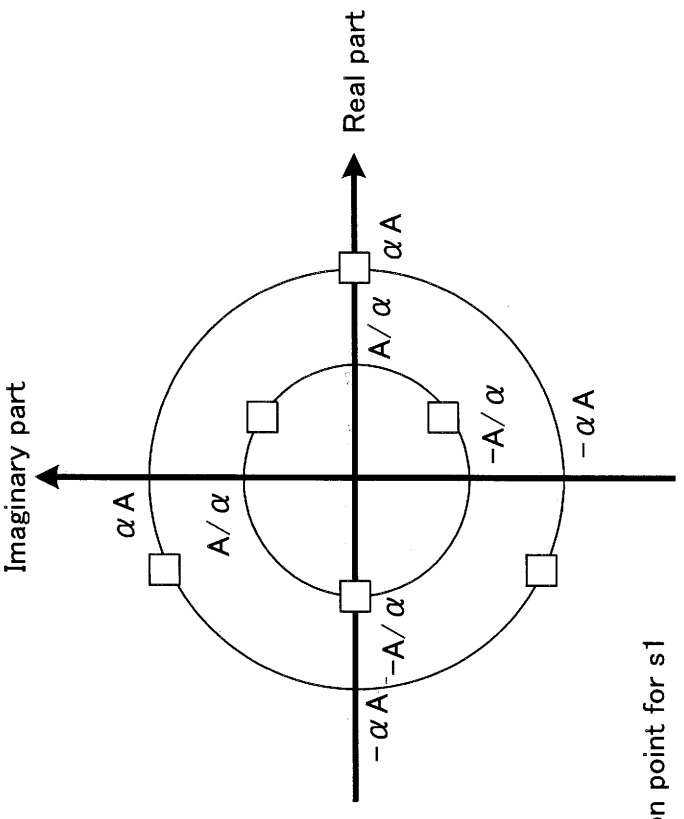


FIG. 61

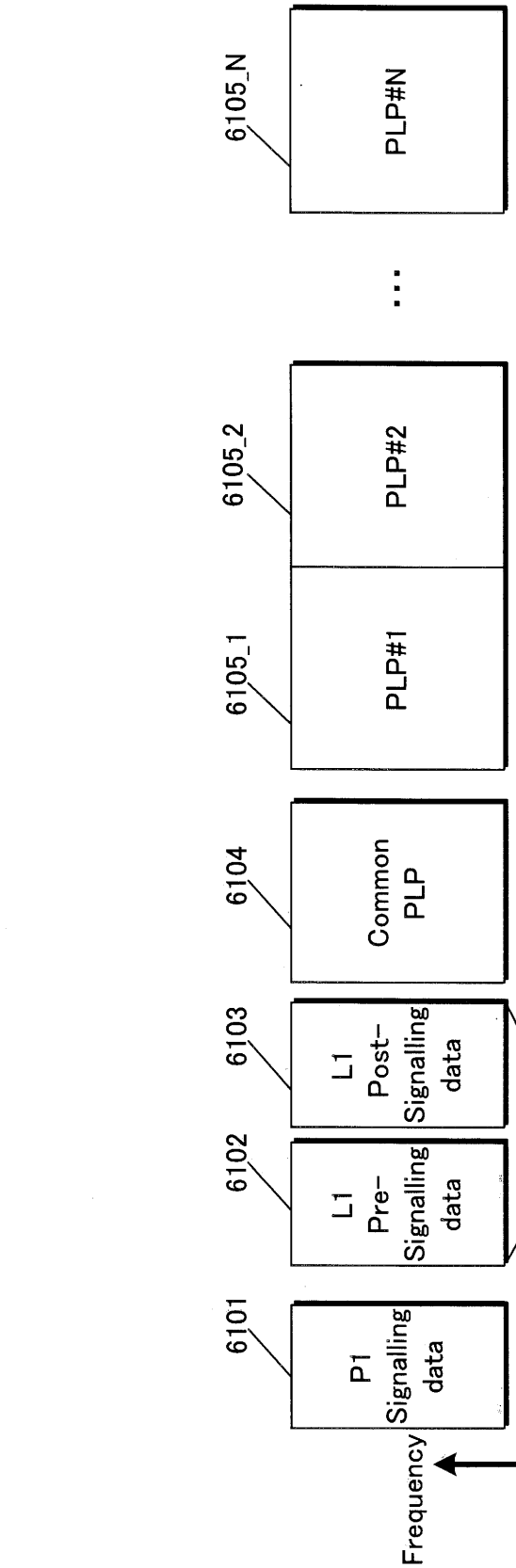

6101
P1 Signalling data
6102
L1 Pre-Signalling data
6103
L1 Post-Signalling data
6104
Common PLP
6105_1
PLP#1
6105_2
PLP#2
...
6105_N
PLP#N
P2 symbols
Time
Frequency

FIG. 62

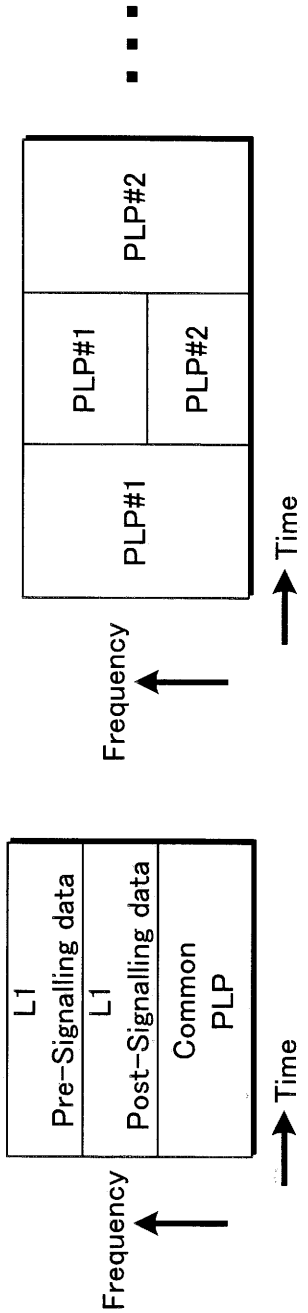

L1
Pre-Signalling data
L1
Post-Signalling data
Common
PLP
Time
Frequency
PLP#1
PLP#2
PLP#1
PLP#2
Time
Frequency

FIG. 63

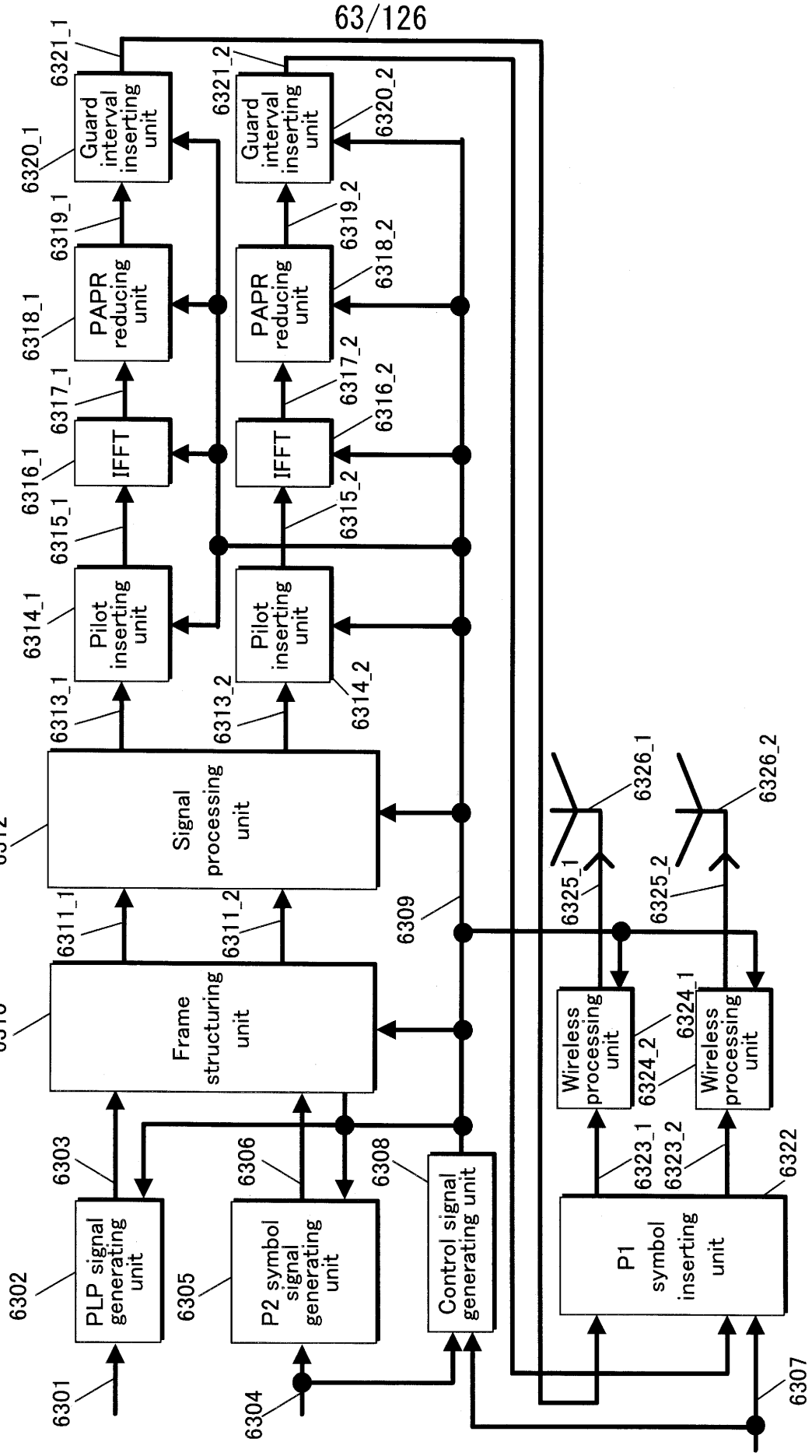

6301
PLP signal generating unit
6302
6303
P2 symbol signal generating unit
6304
6305
6306
Control signal generating unit
6307
6308
6309
Frame structuring unit
6310
6311_1
6311_2
Signal processing unit
6312
6313_1
6313_2
Pilot inserting unit
6314_1
6314_2
6315_1
6315_2
IFFT
6316_1
6316_2
6317_1
6317_2
PAPR reducing unit
6318_1
6318_2
6319_1
6319_2
Guard interval inserting unit
6320_1
6320_2
6321_1
6321_2
P1 symbol inserting unit
6322
6323_1
6323_2
Wireless processing unit
6324_1
6324_2
6325_1
6325_2
6326_1
6326_2

FIG. 64

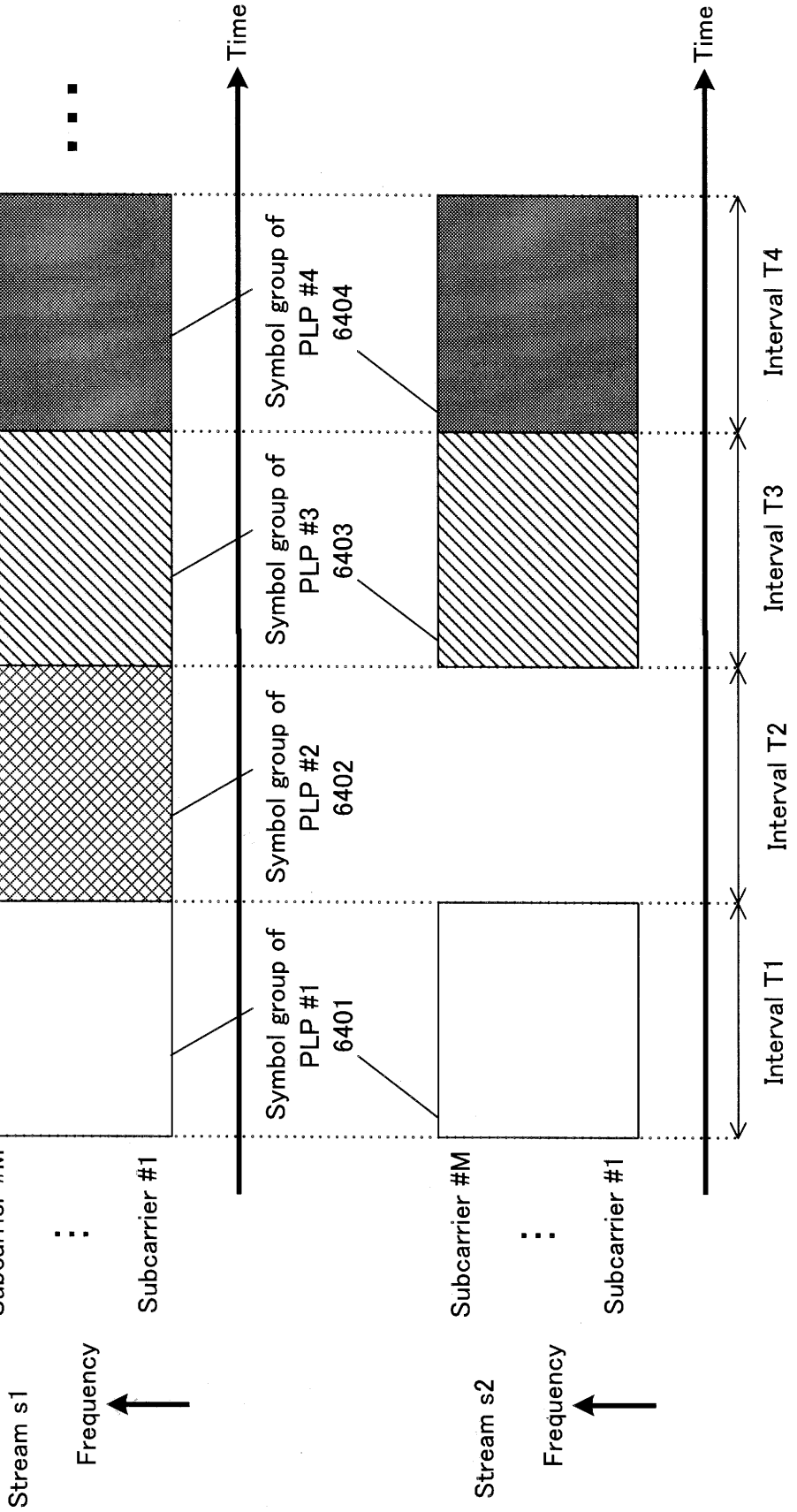

Time
Symbol group of PLP #4 6404
Symbol group of PLP #3 6403
Symbol group of PLP #2 6402
Symbol group of PLP #1 6401
Interval T4
Interval T3
Interval T2
Interval T1
Subcarrier #M
Subcarrier #1
Frequency
Stream s1
Stream s2

FIG. 65

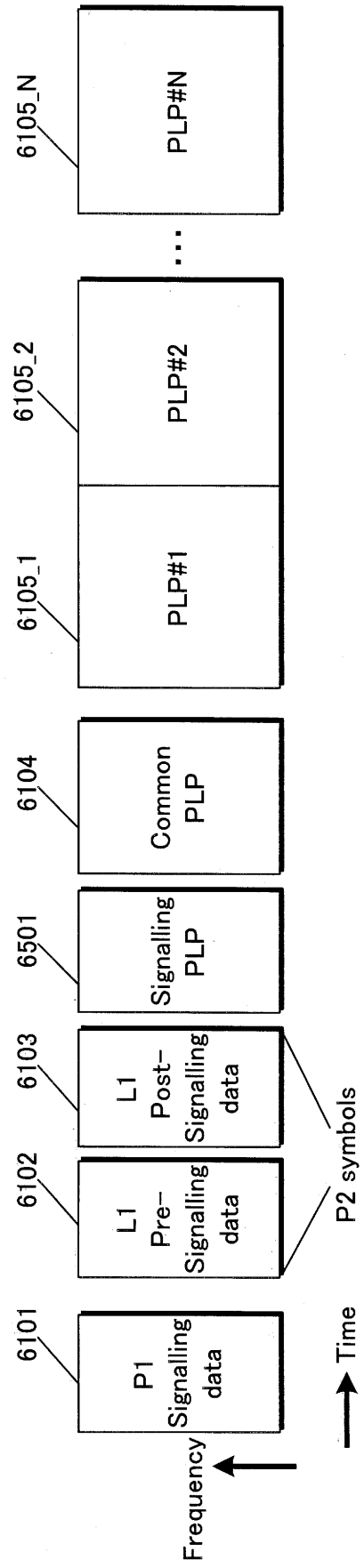

6101
P1 Signalling data
6102
L1 Pre-Signalling data
6103
L1 Post-Signalling data
6501
Signalling PLP
6104
Common PLP
6105_1
PLP#1
6105_2
PLP#2
...
6105_N
PLP#N
P2 symbols
Time
Frequency

FIG. 66

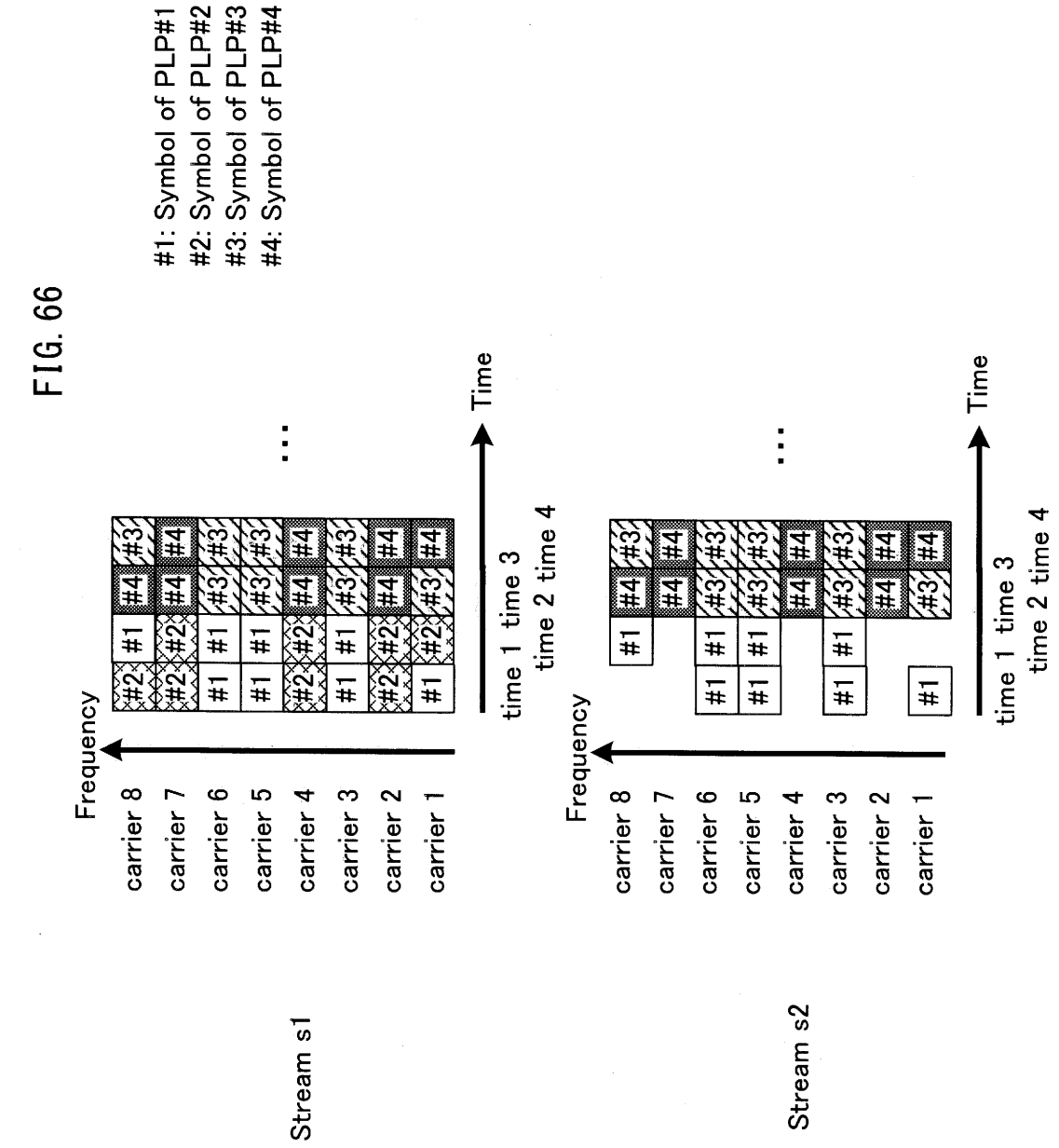

#1: Symbol of PLP#1
#2: Symbol of PLP#2
#3: Symbol of PLP#3
#4: Symbol of PLP#4
Stream s1
Frequency
carrier 8
carrier 7
carrier 6
carrier 5
carrier 4
carrier 3
carrier 2
carrier 1
Time
time 1 time 3
time 2 time 4
Stream s2
Frequency
carrier 8
carrier 7
carrier 6
carrier 5
carrier 4
carrier 3
carrier 2
carrier 1
Time
time 1 time 3
time 2 time 4

FIG. 67

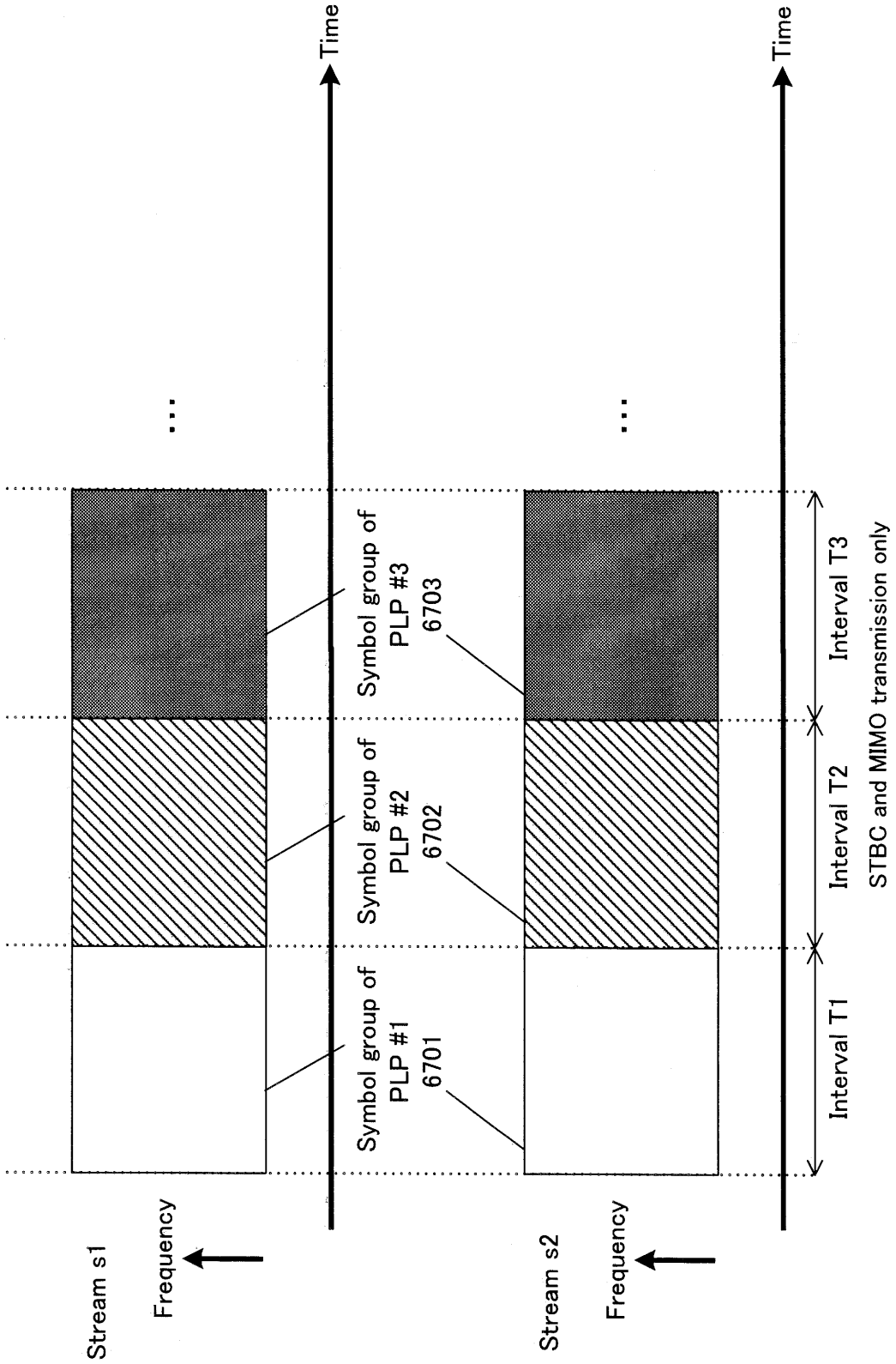

Time
Time
Symbol group of PLP #3
6703
Symbol group of PLP #2
6702
Symbol group of PLP #1
6701
Interval T3
Interval T2
Interval T1
STBC and MIMO transmission only
Stream s1
Frequency
Stream s2
Frequency

FIG. 68

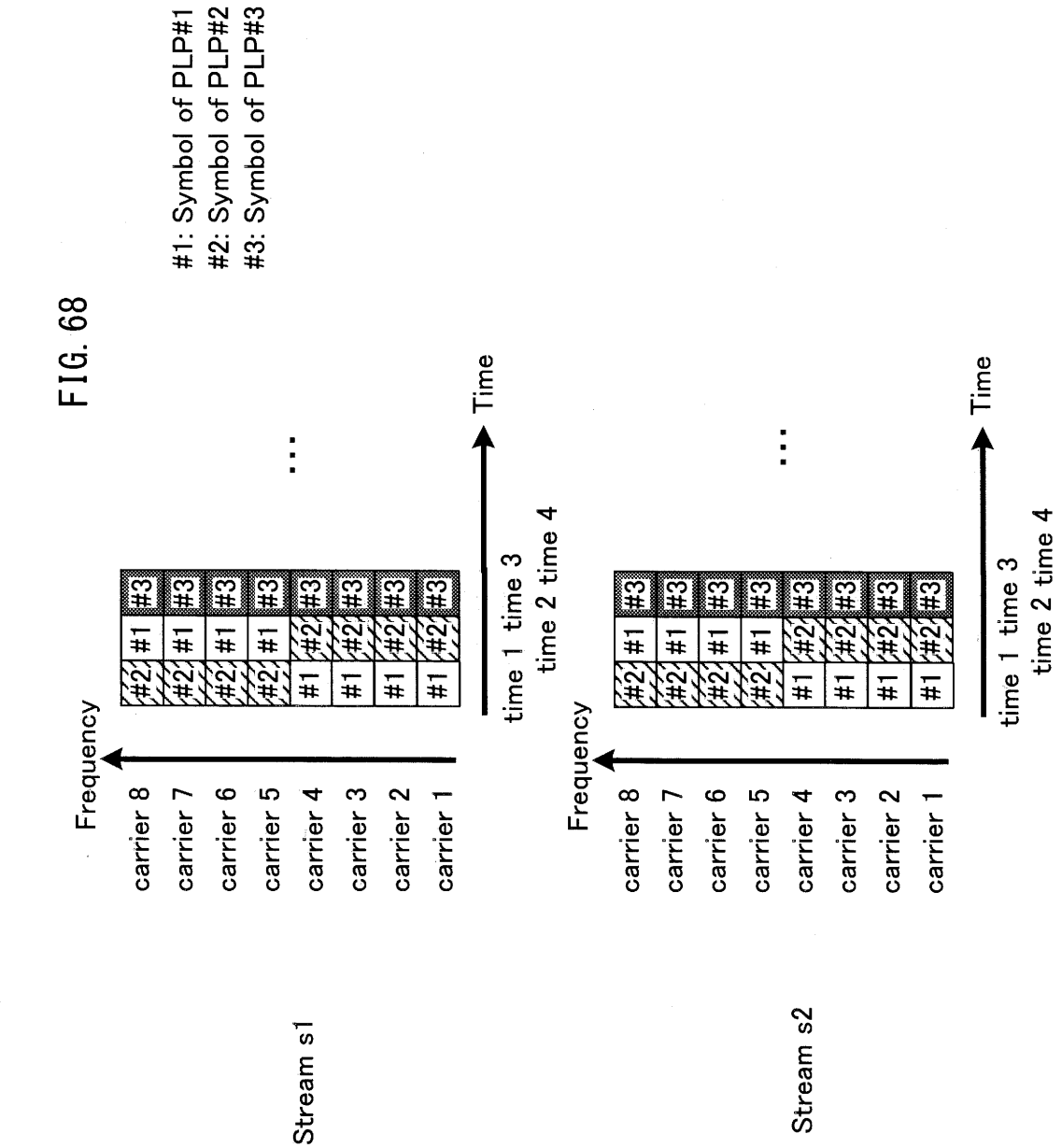

#1: Symbol of PLP#1
#2: Symbol of PLP#2
#3: Symbol of PLP#3
Stream s1
Frequency
carrier 8
carrier 7
carrier 6
carrier 5
carrier 4
carrier 3
carrier 2
carrier 1
Time
time 1 time 3
time 2 time 4
Stream s2
Frequency
carrier 8
carrier 7
carrier 6
carrier 5
carrier 4
carrier 3
carrier 2
carrier 1
Time
time 1 time 3
time 2 time 4

FIG. 69

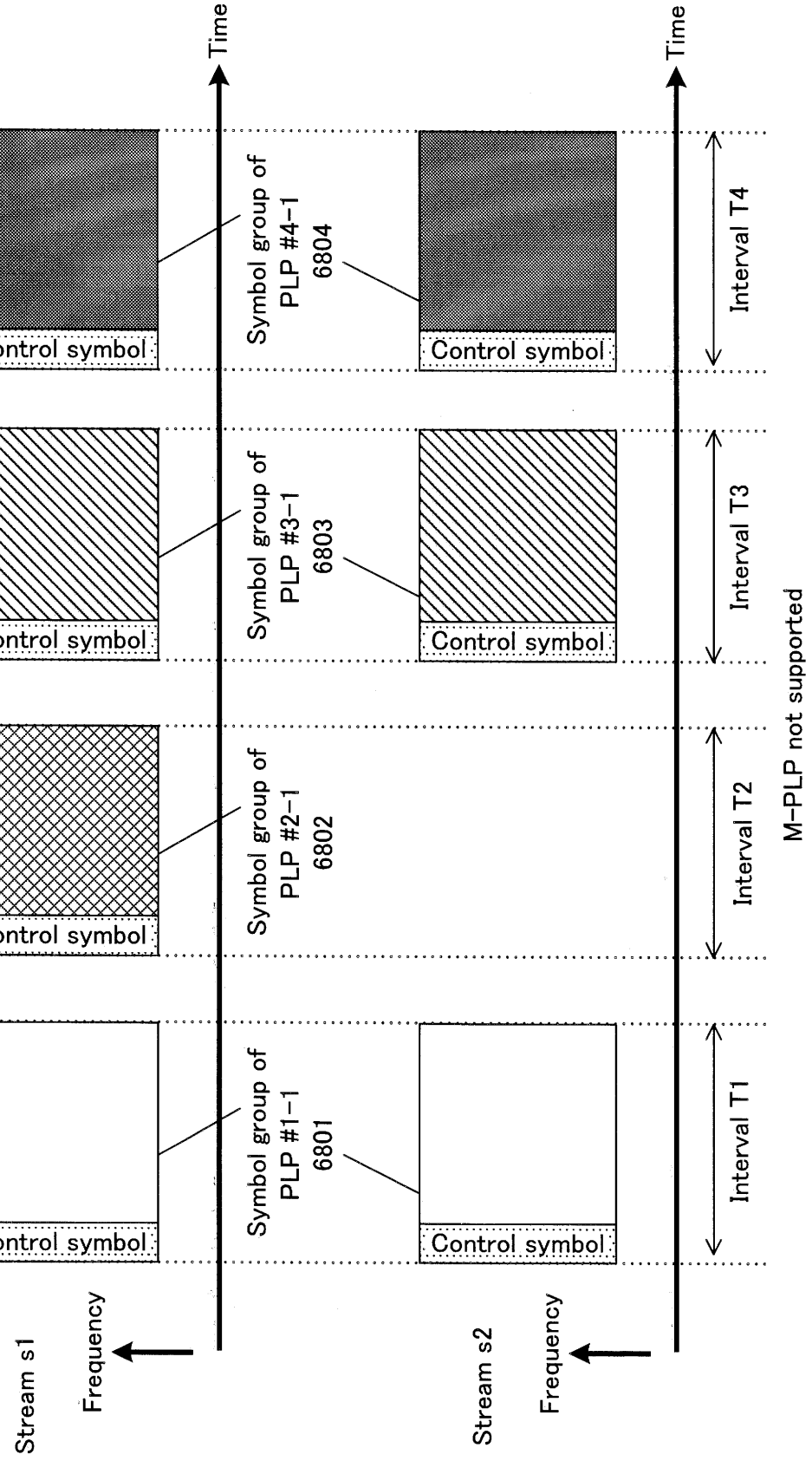

Time
Time
Symbol group of PLP #4-1 6804
Symbol group of PLP #3-1 6803
Symbol group of PLP #2-1 6802
Symbol group of PLP #1-1 6801
Control symbol
Control symbol
Control symbol
Control symbol
Control symbol
Control symbol
Control symbol
Control symbol
Interval T4
Interval T3
Interval T2
Interval T1
M-PLP not supported
Stream s1
Frequency
Stream s2
Frequency

FIG. 70

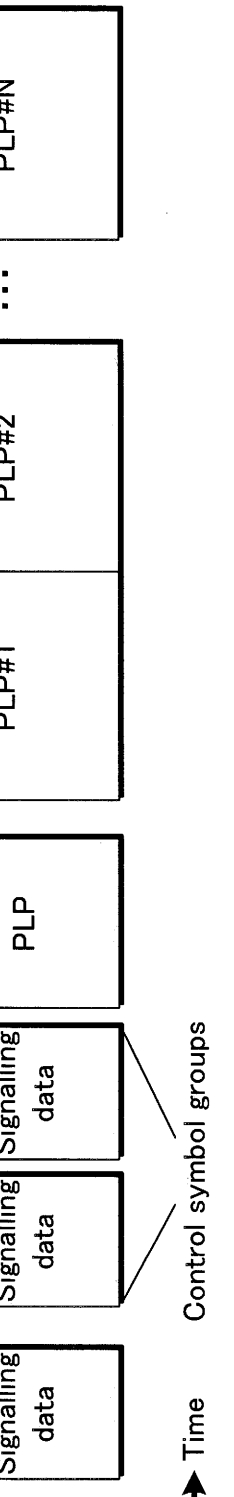

6101
P1 Signalling data
7001
First Signalling data
7002
Second Signalling data
6104
Common PLP
6105_1
PLP#1
6105_2
PLP#2
6105_N
PLP#N
Control symbol groups
Time
Frequency

FIG. 71

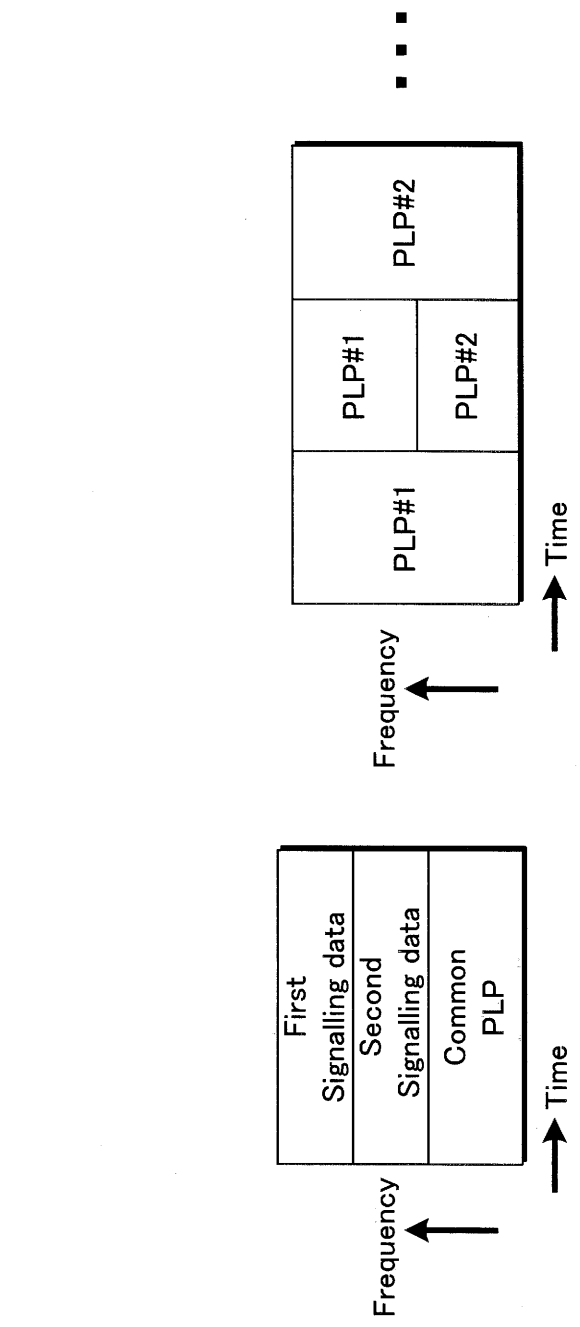

First Signalling data
Second Signalling data
Common PLP
Time
Frequency
PLP#1
PLP#2
PLP#1
PLP#2
Time
Frequency

FIG. 72

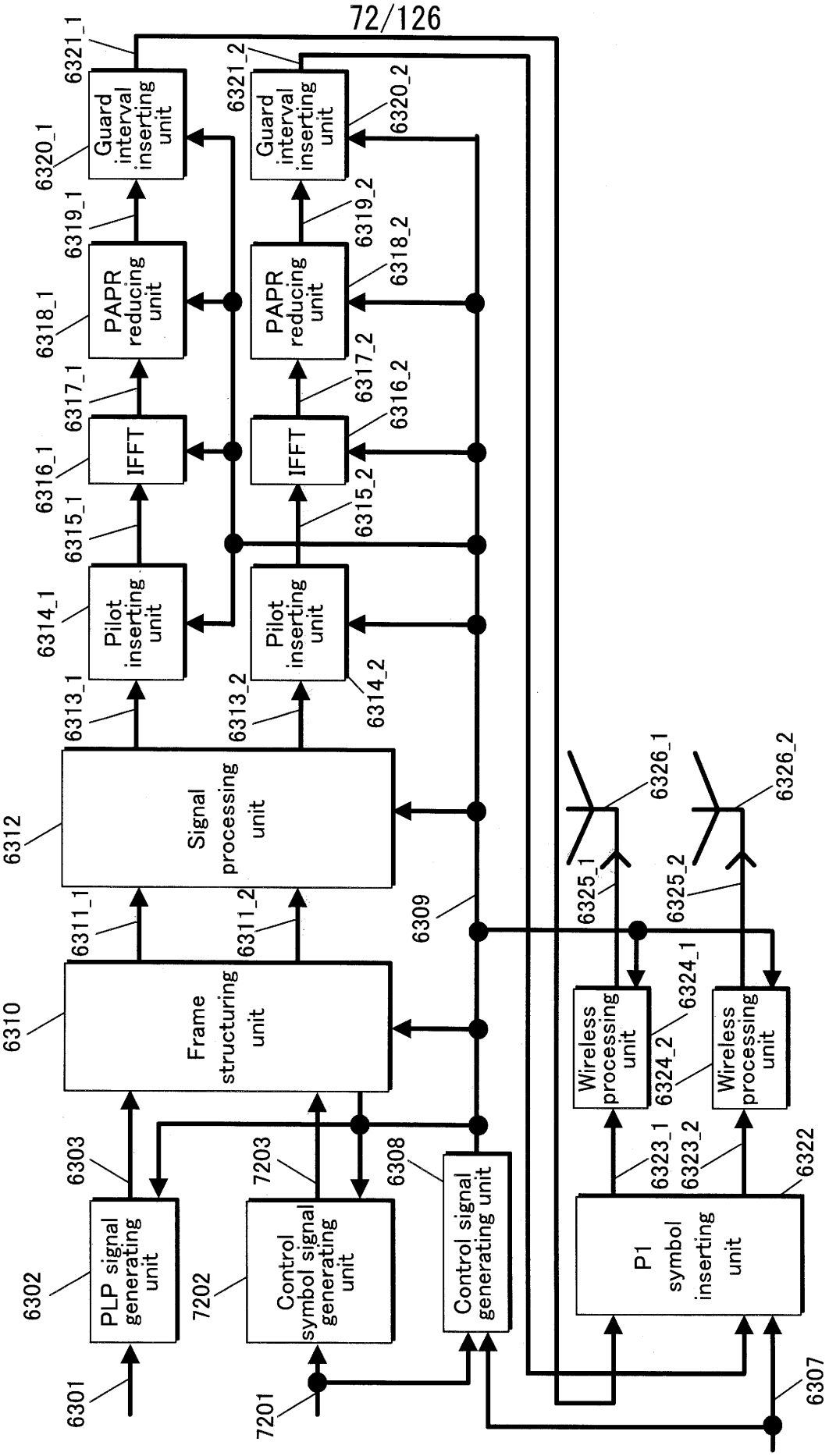

6301
PLP signal generating unit
6302
6303
Control symbol signal generating unit
7201
7202
7203
Control signal generating unit
6308
Frame structuring unit
6310
6311_1
6311_2
Signal processing unit
6312
6313_1
6313_2
Pilot inserting unit
6314_1
6314_2
IFFT
6315_1
6315_2
6316_1
6316_2
PAPR reducing unit
6317_1
6317_2
6318_1
6318_2
Guard interval inserting unit
6319_1
6319_2
6320_1
6320_2
6321_1
6321_2
6309
P1 symbol inserting unit
6322
6323_1
6323_2
Wireless processing unit
6324_1
6324_2
6325_1
6325_2
6326_1
6326_2
6307

FIG. 73

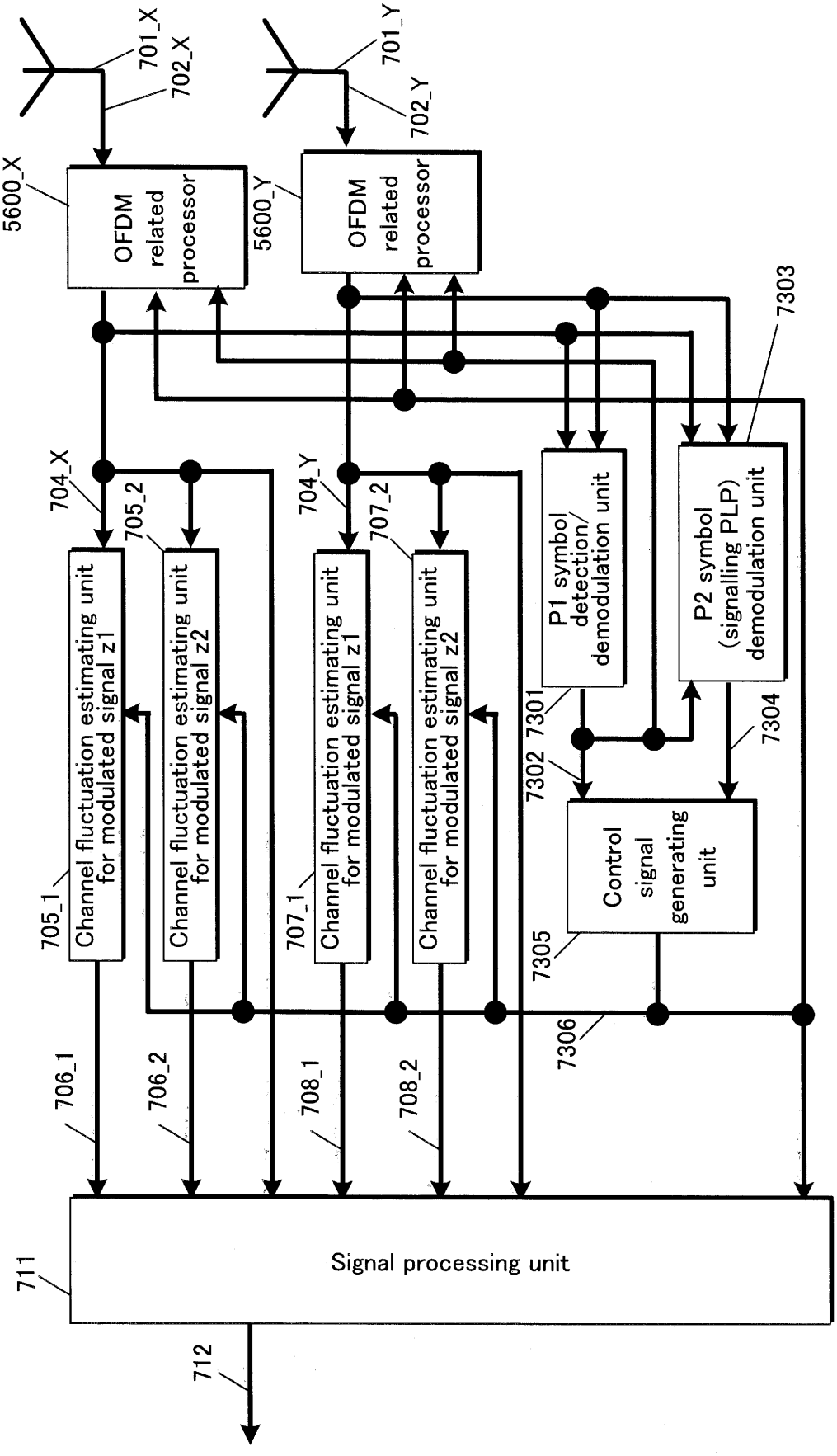

701_X
702_X
701_Y
702_Y
5600_X
OFDM related processor
5600_Y
OFDM related processor
7303
704_X
705_2
704_Y
707_2
P1 symbol detection/ demodulation unit
P2 symbol (signalling PLP) demodulation unit
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
705_1
707_1
7301
7304
7302
Control signal generating unit
7305
7306
706_1
706_2
708_1
708_2
Signal processing unit
711
712

FIG. 74

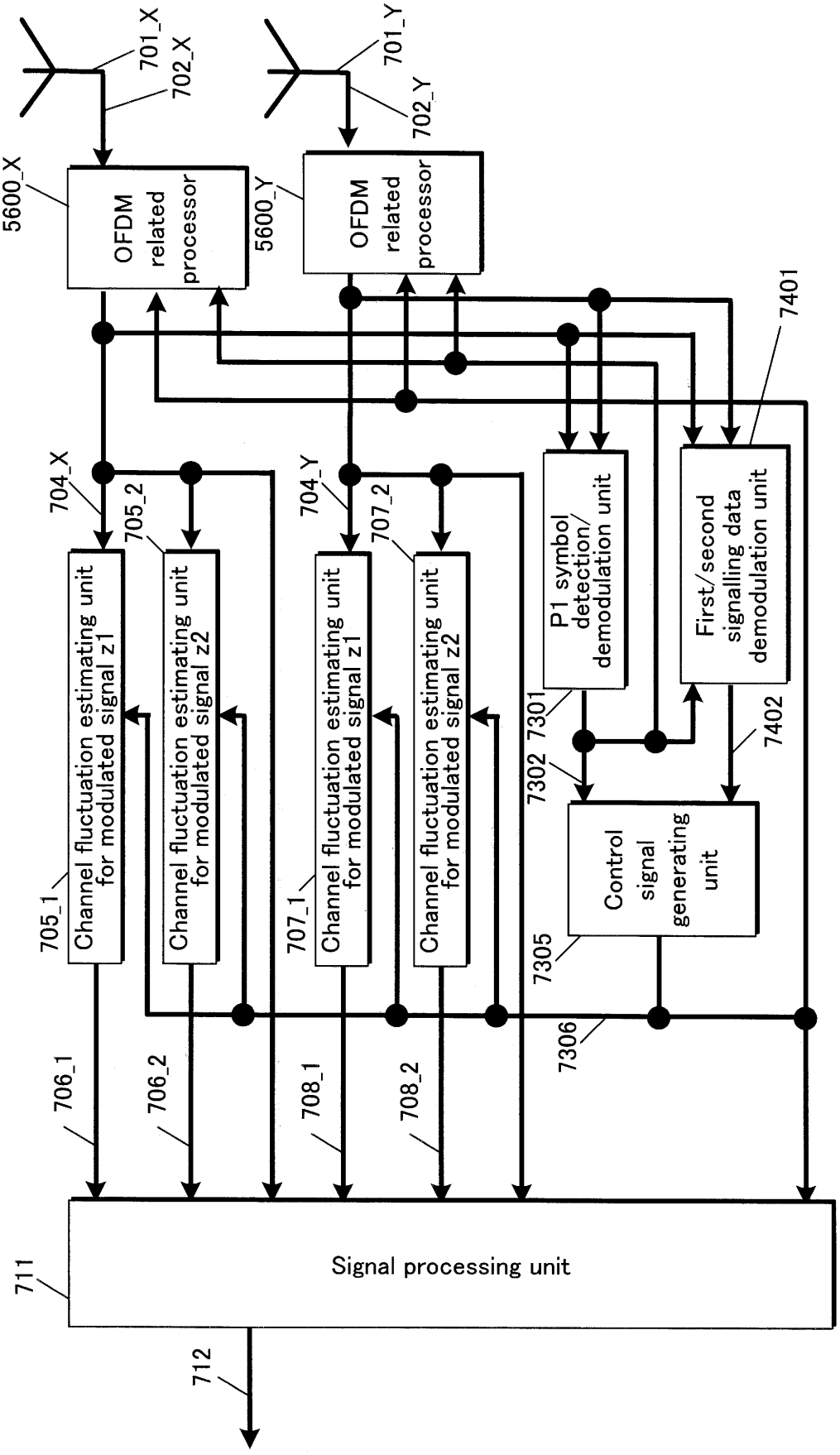

701_X
702_X
701_Y
702_Y
5600_X
OFDM related processor
5600_Y
OFDM related processor
7401
704_X
705_2
704_Y
707_2
P1 symbol detection/ demodulation unit
First/second signalling data demodulation unit
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
7301
7402
7302
Control signal generating unit
705_1
707_1
7305
7306
706_1
706_2
708_1
708_2
711
Signal processing unit
712

FIG. 75

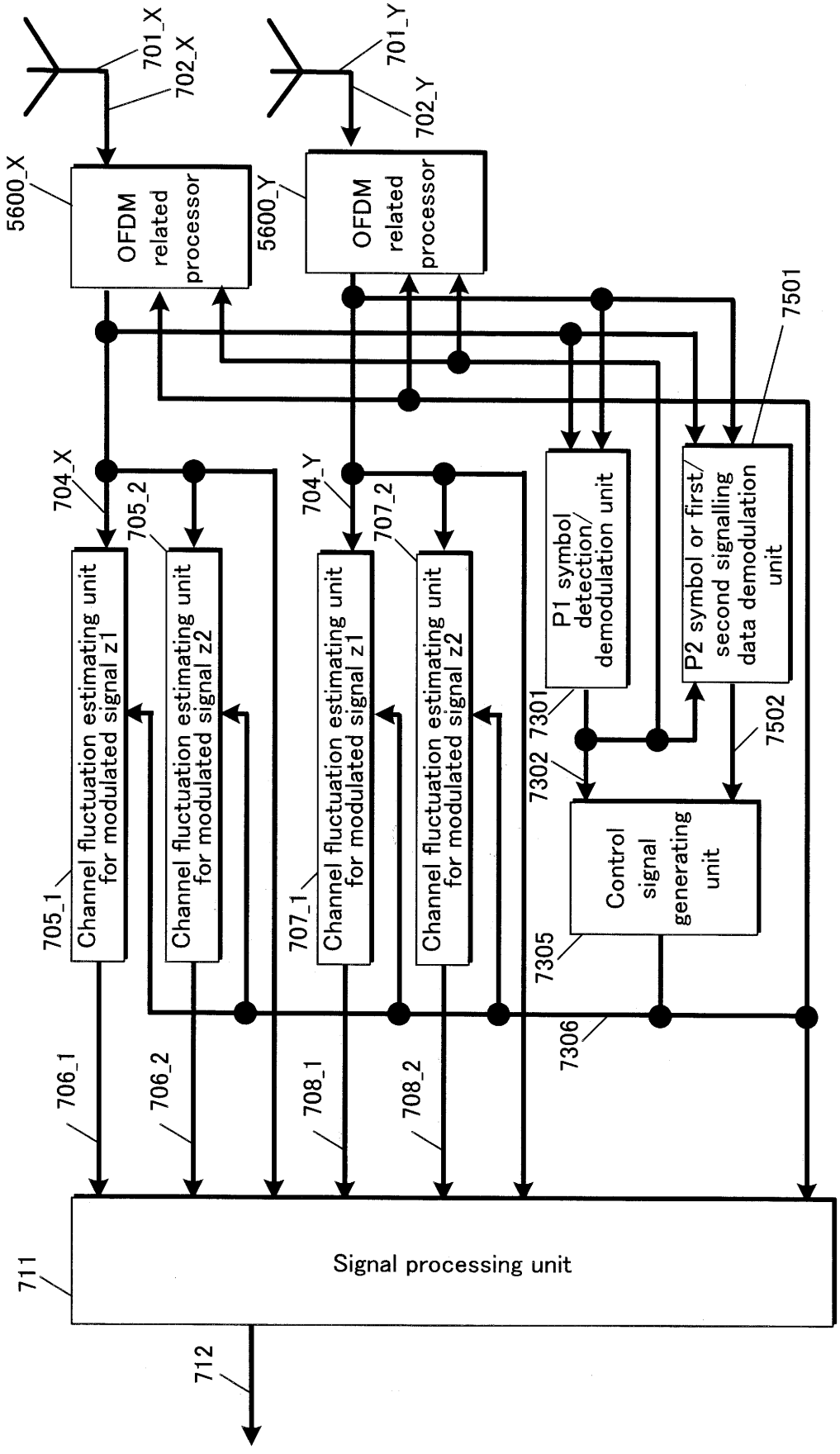

701_X
702_X
701_Y
702_Y
5600_X
OFDM related processor
5600_Y
OFDM related processor
7501
704_X
705_2
704_Y
707_2
P1 symbol detection/ demodulation unit
P2 symbol or first/ second signalling data demodulation unit
705_1
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
707_1
Channel fluctuation estimating unit for modulated signal z1
Channel fluctuation estimating unit for modulated signal z2
7301
7502
7302
Control signal generating unit
7305
7306
706_1
706_2
708_1
708_2
711
Signal processing unit
712

FIG. 76A

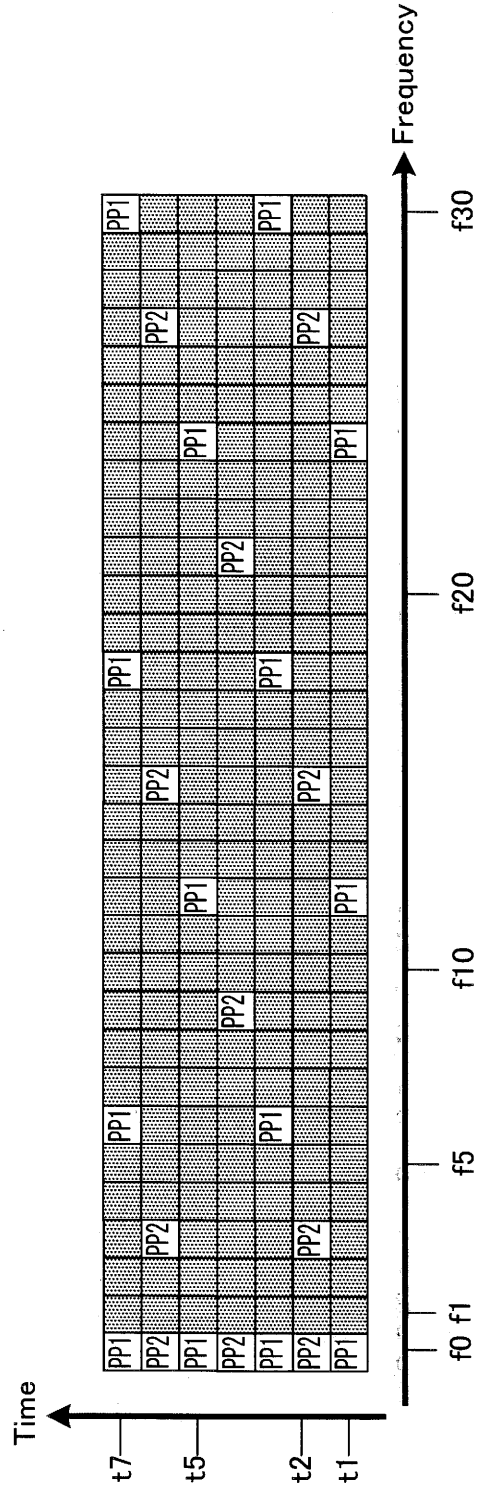


FIG. 76B

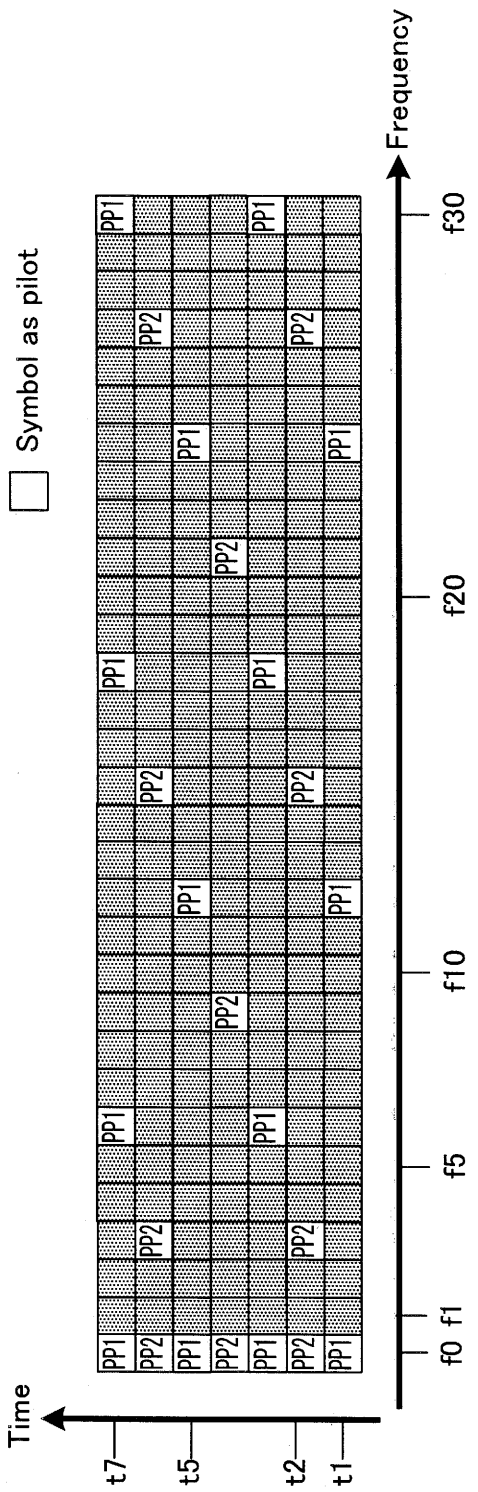


FIG. 77A

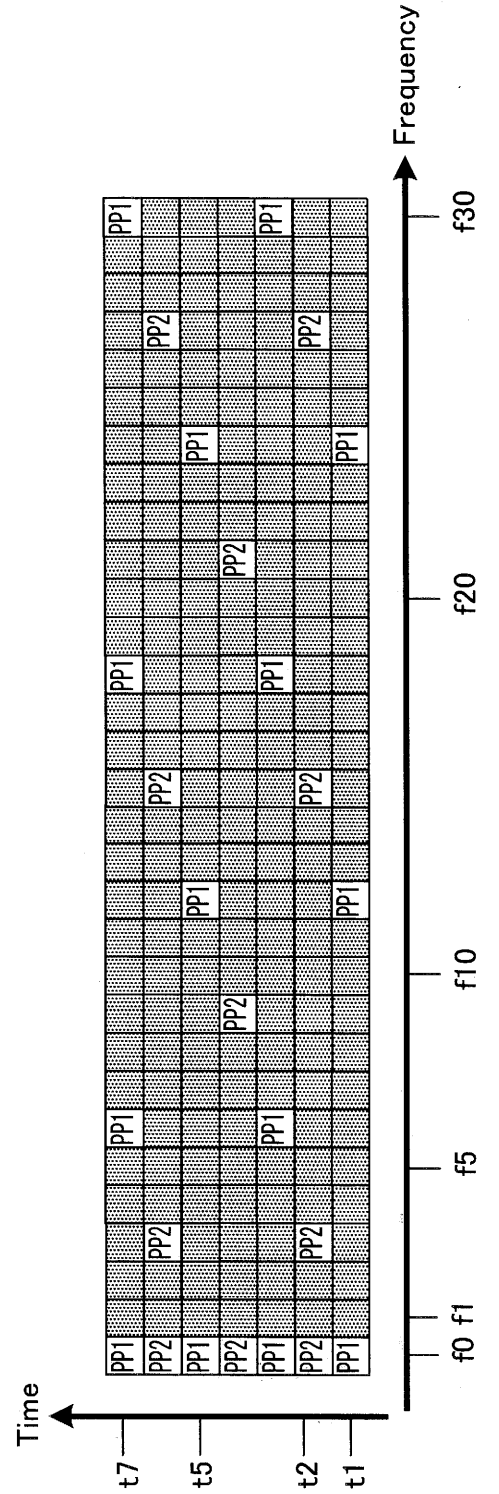


FIG. 77B

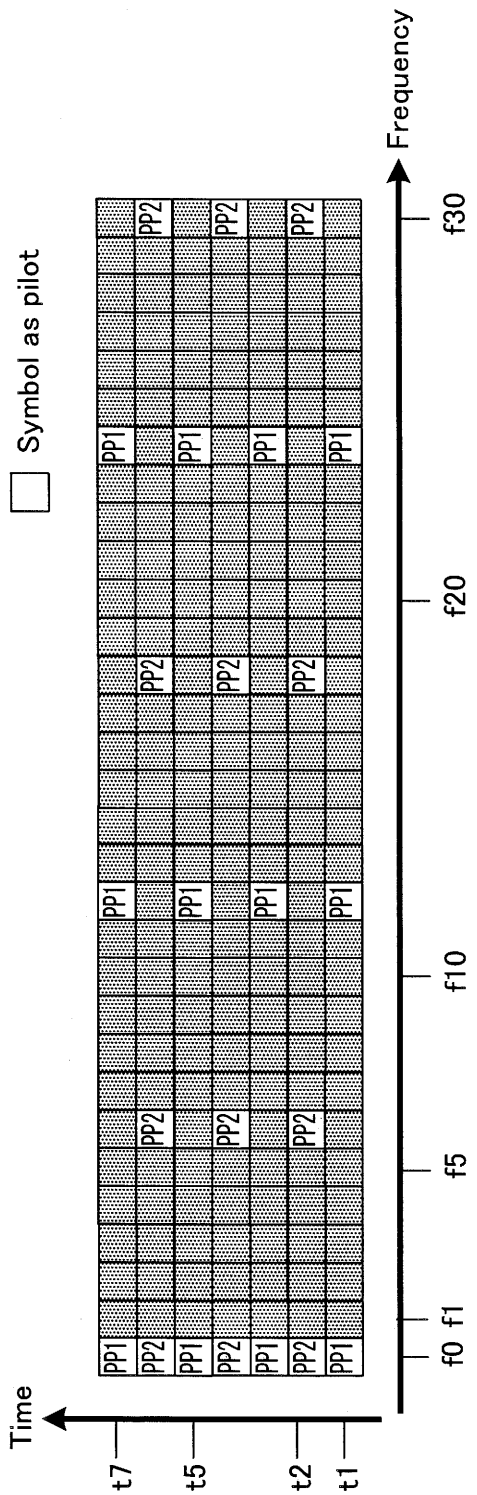


FIG. 78A

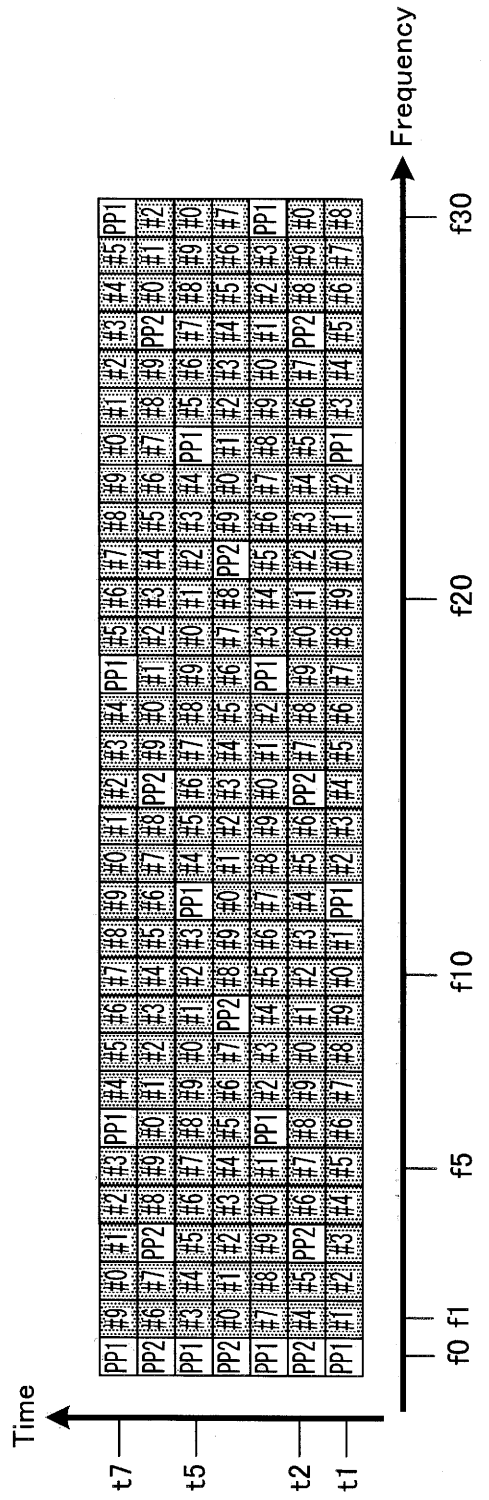


FIG. 78B

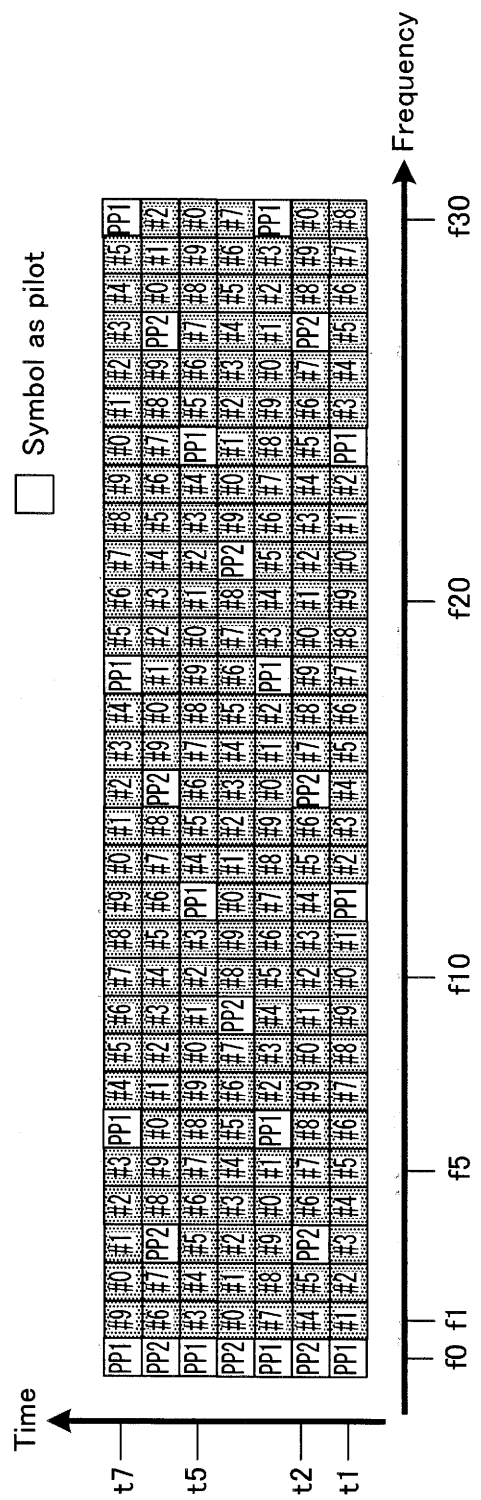


FIG. 79A

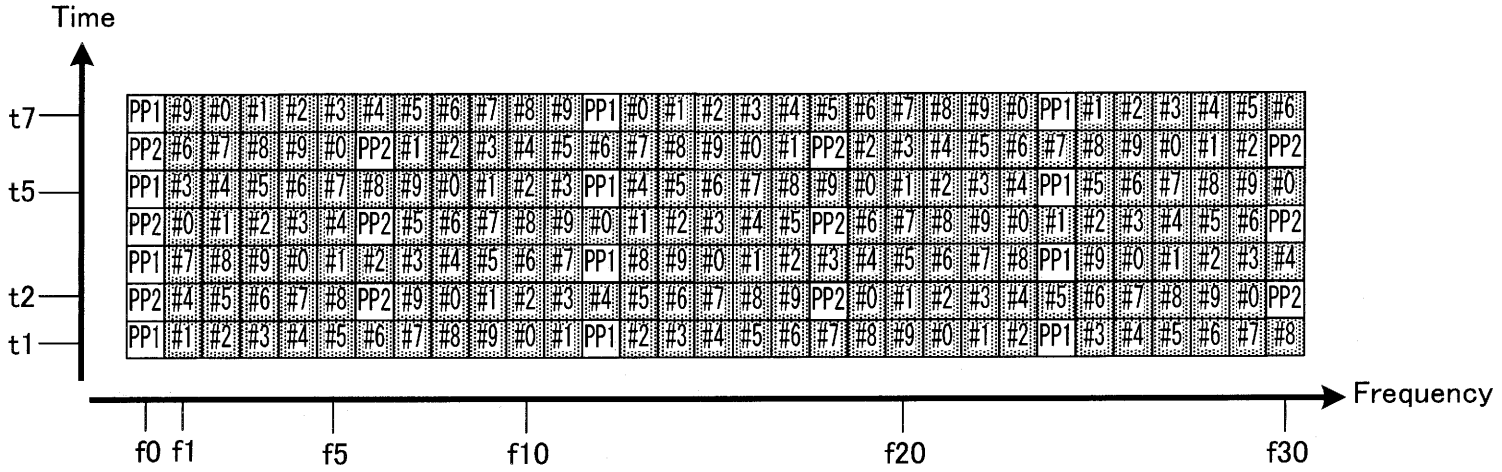


FIG. 79B

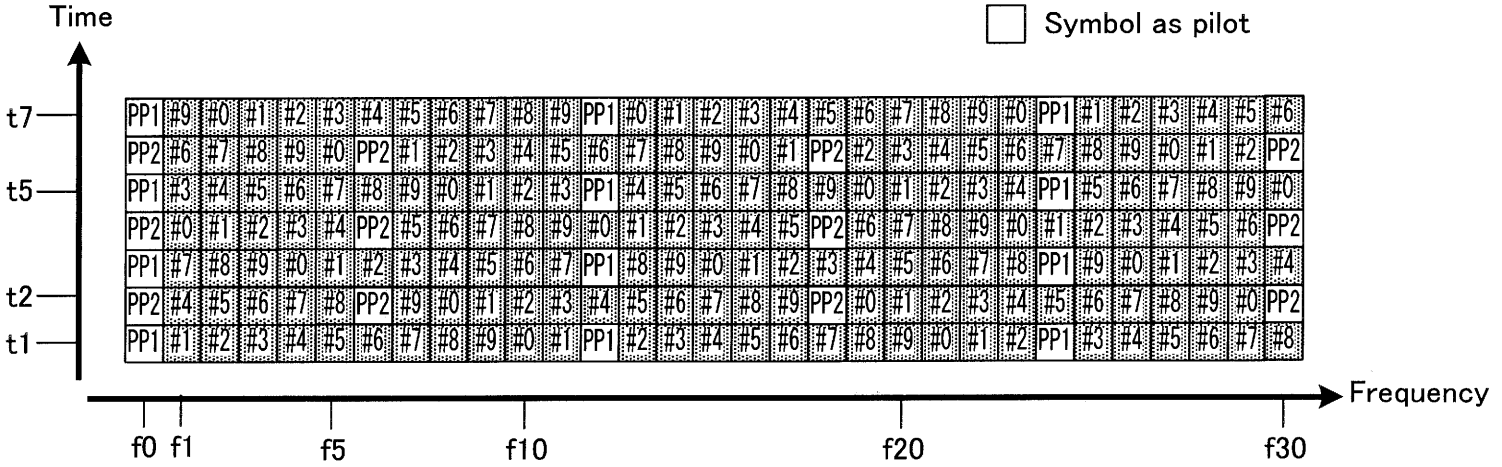


FIG. 80A

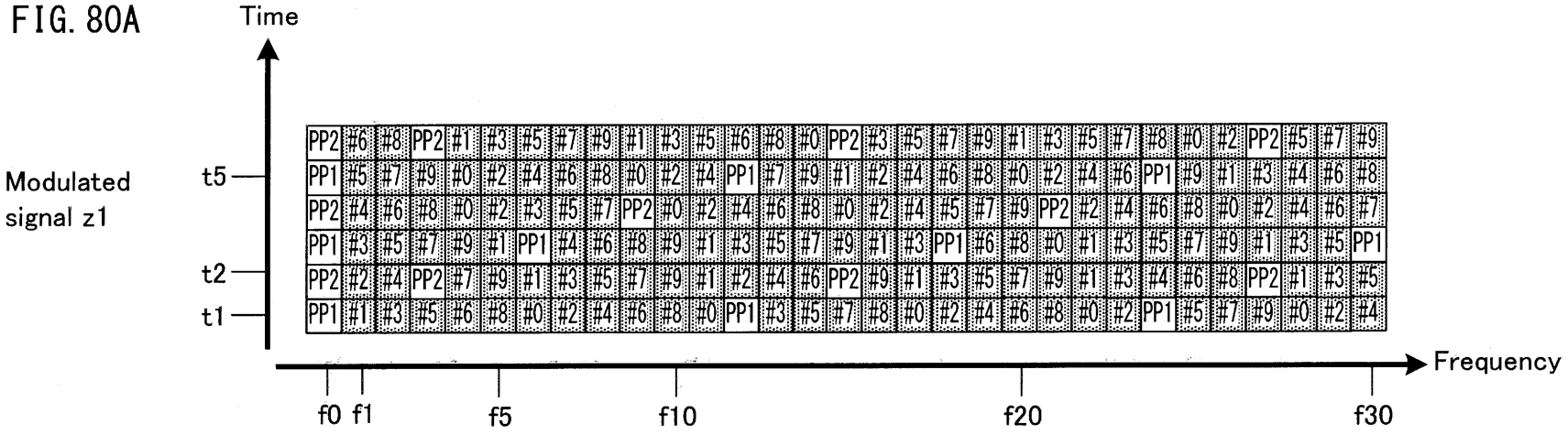


FIG. 80B

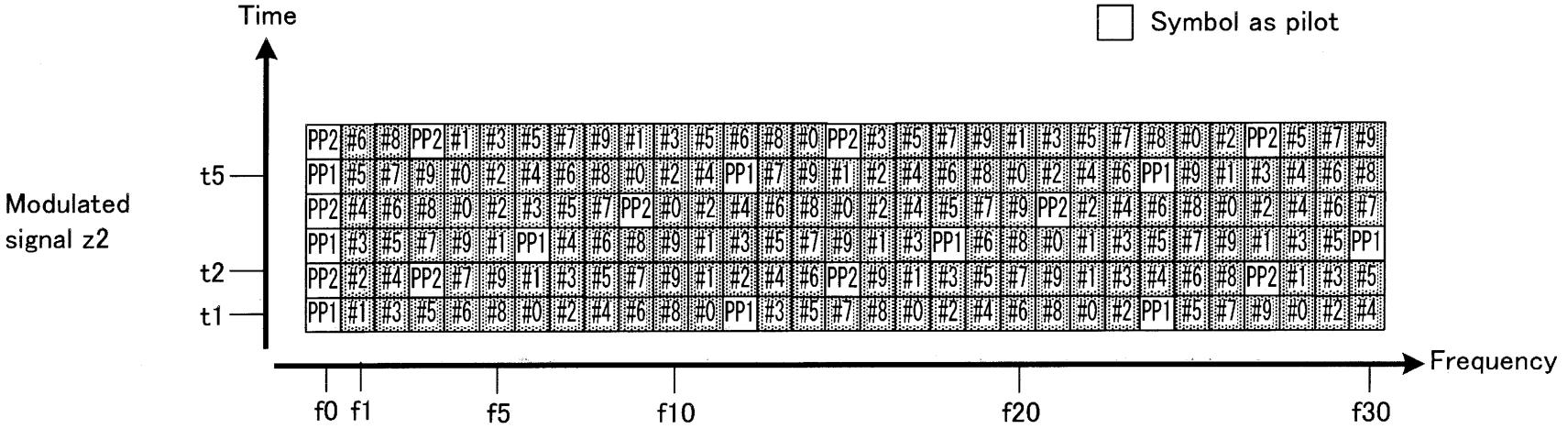


FIG. 81

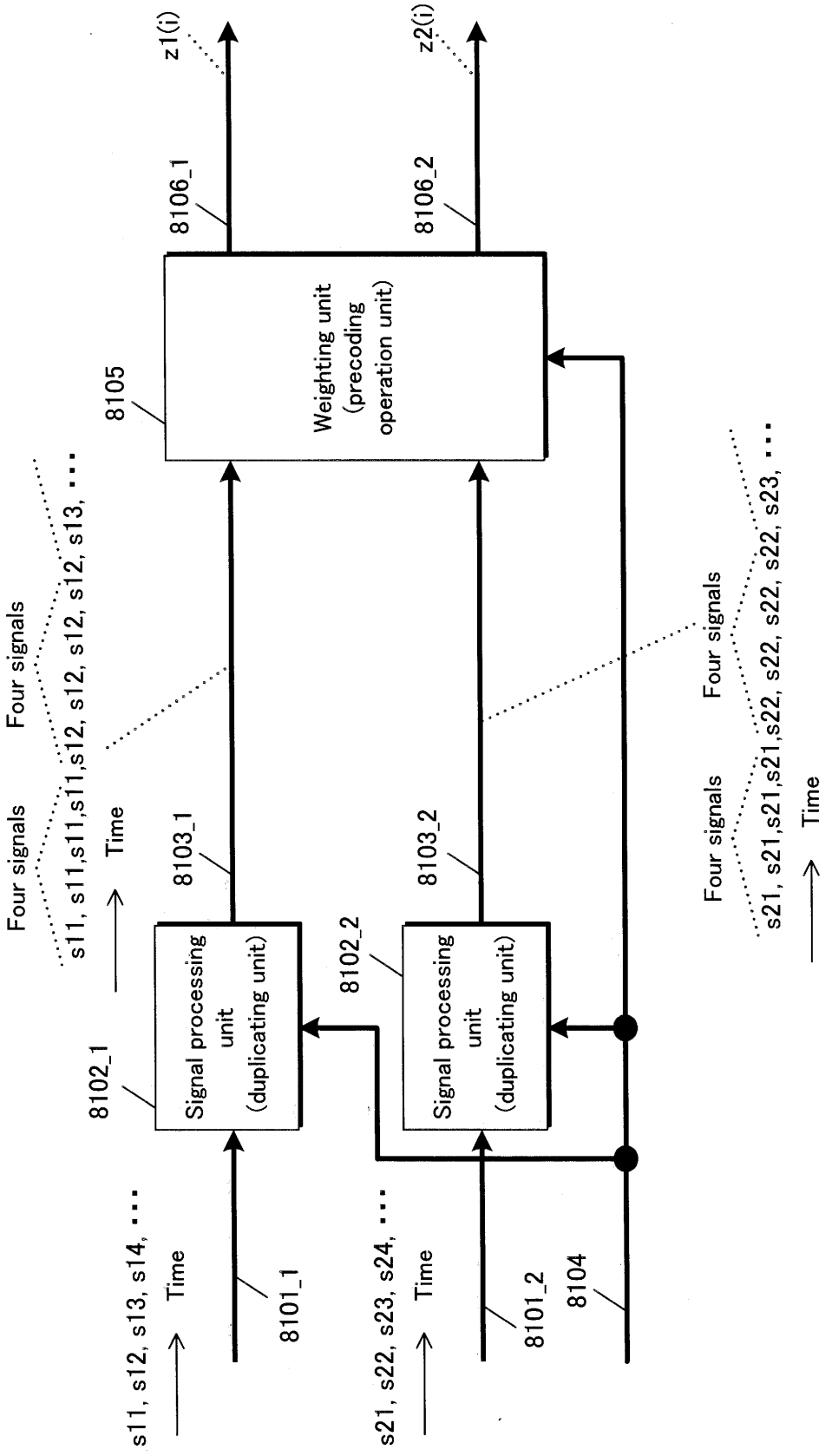

z1(i)
z2(i)
8106_1
8106_2
8105
Weighting unit
(precoding
operation unit)
Four signals
s11, s11,s11,s11,s12, s12, s12, s12, s13, ...
Time
8103_1
8103_2
8102_1
8102_2
Signal processing
unit
(duplicating unit)
Signal processing
unit
(duplicating unit)
s11, s12, s13, s14, ...
Time
s21, s22, s23, s24, ...
Time
8101_1
8101_2
8104
Four signals
s21, s21,s21,s21,s22, s22, s22, s22, s23, ...
Time

FIG. 82

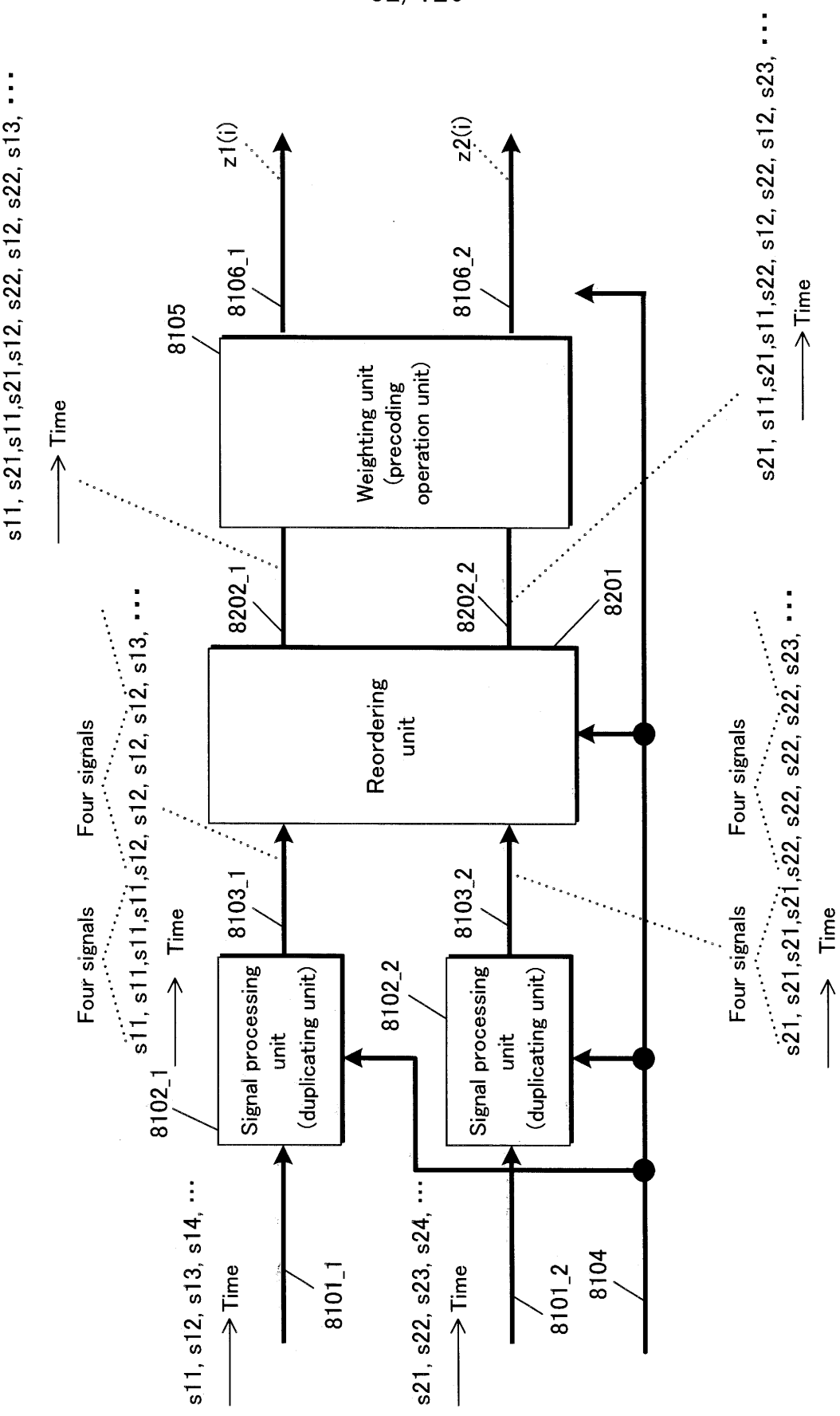

s11, s21,s11,s21,s12, s22, s12, s22, s13, ...
Time
z1(i)
z2(i)
8105
8106_1
8106_2
Weighting unit (precoding operation unit)
8202_1
8202_2
8201
Reordering unit
Four signals
s11, s11,s11,s11,s12, s12, s12, s12, s13, ...
Time
8103_1
8103_2
8102_1
8102_2
Signal processing unit (duplicating unit)
Signal processing unit (duplicating unit)
s11, s12, s13, s14, ...
s21, s22, s23, s24, ...
8101_1
8101_2
8104
s21, s11,s21,s11,s22, s12, s22, s12, s23, ...
s21, s21,s21,s21,s22, s22, s22, s22, s23, ...

FIG. 83

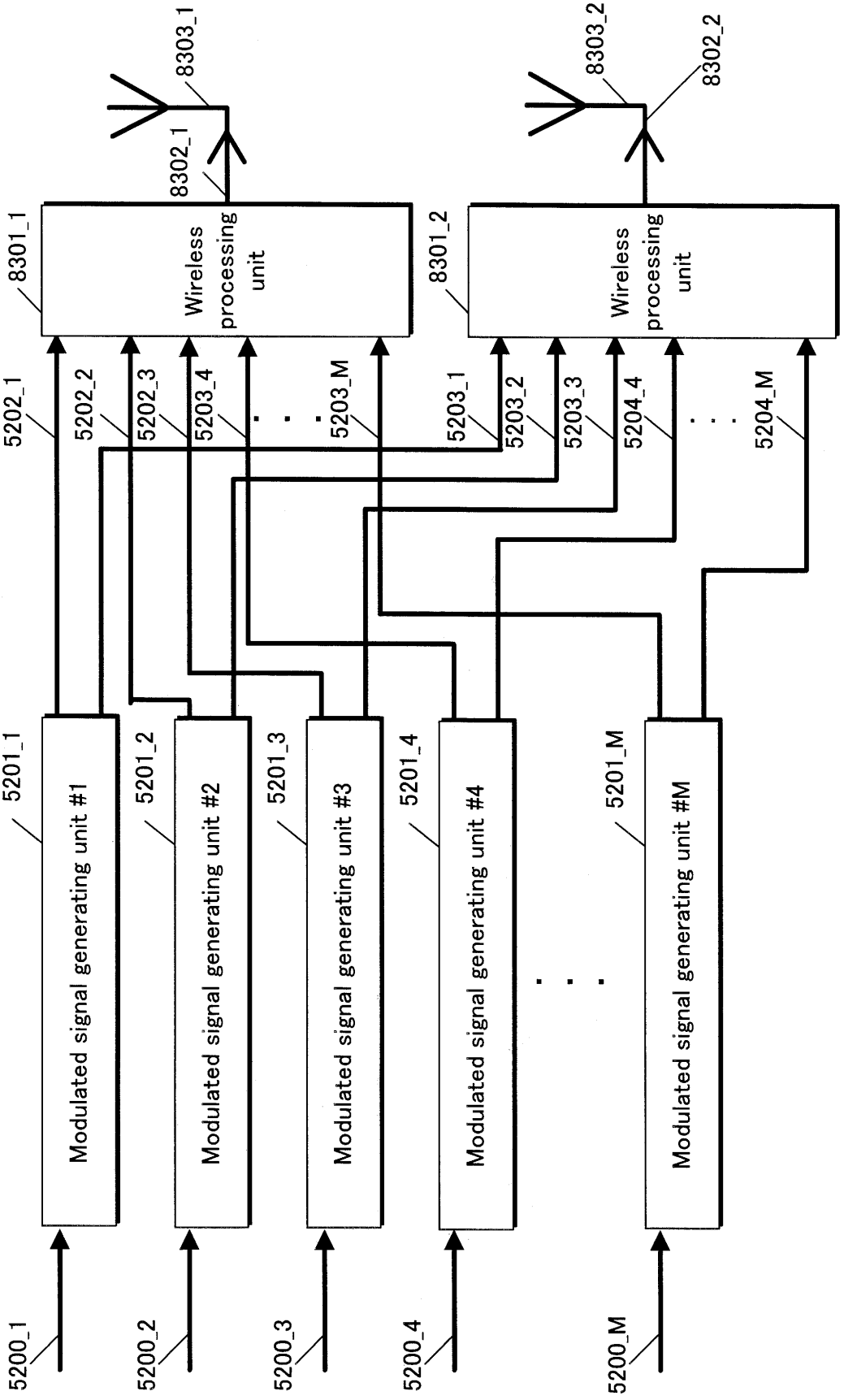

5200_1
5200_2
5200_3
5200_4
5200_M
5201_1
5201_2
5201_3
5201_4
5201_M
Modulated signal generating unit #1
Modulated signal generating unit #2
Modulated signal generating unit #3
Modulated signal generating unit #4
Modulated signal generating unit #M
5202_1
5202_2
5202_3
5203_4
5203_M
5203_1
5203_2
5203_3
5204_4
5204_M
8301_1
8301_2
Wireless processing unit
Wireless processing unit
8302_1
8303_1
8303_2
8302_2

FIG. 84

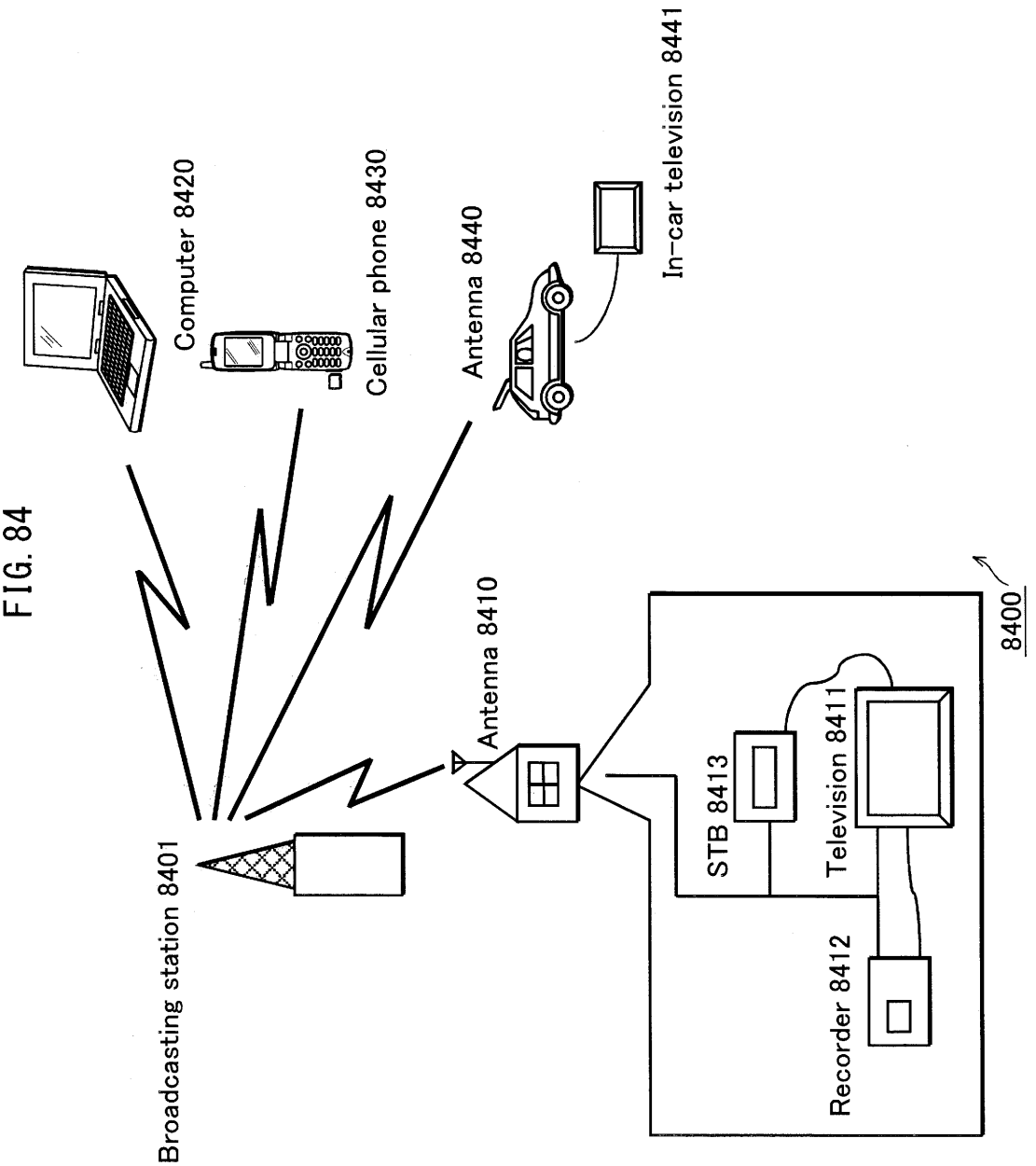

Broadcasting station 8401
Computer 8420
Cellular phone 8430
Antenna 8440
In-car television 8441
Antenna 8410
STB 8413
Television 8411
Recorder 8412
8400

FIG. 85

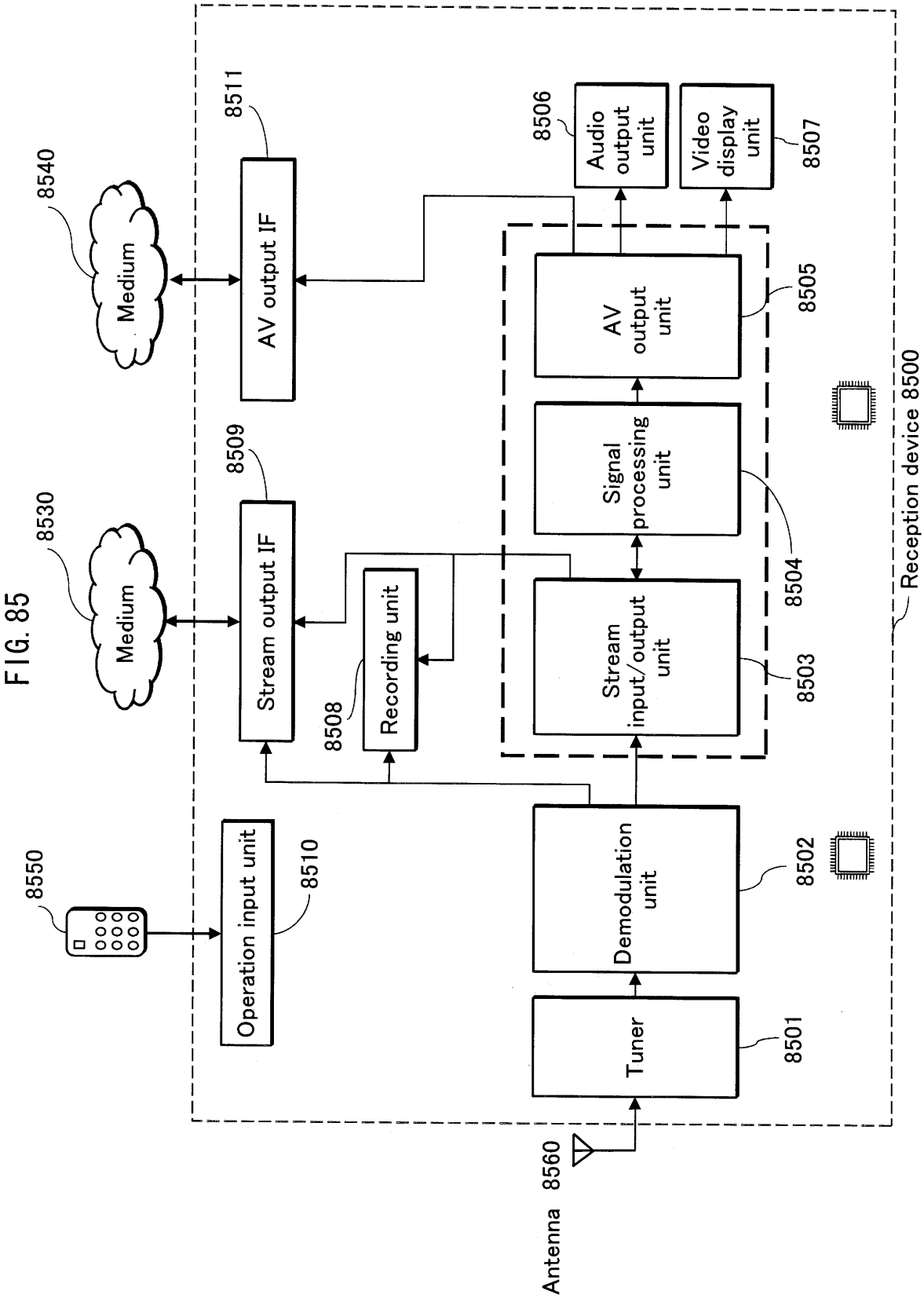

Reception device 8500
Antenna
8560
Tuner
8501
Demodulation unit
8502
Stream input/output unit
8503
Signal processing unit
8504
AV output unit
8505
Audio output unit
8506
Video display unit
8507
Recording unit
8508
Stream output IF
8509
AV output IF
8511
Operation input unit
8510
8550
Medium
8530
Medium
8540

FIG. 86

Video stream (PID=0x1011 primary video)
Audio stream (PID=0x1100)
Audio stream (PID=0x1101)
Presentation graphics stream (PID=0x1200)
Presentation graphics stream (PID=0x1201)
Interactive graphics stream (PID=0x1400)
Video stream (PID=0x1B00 secondary video)
Video stream (PID=0x1B01 secondary video)

FIG. 87

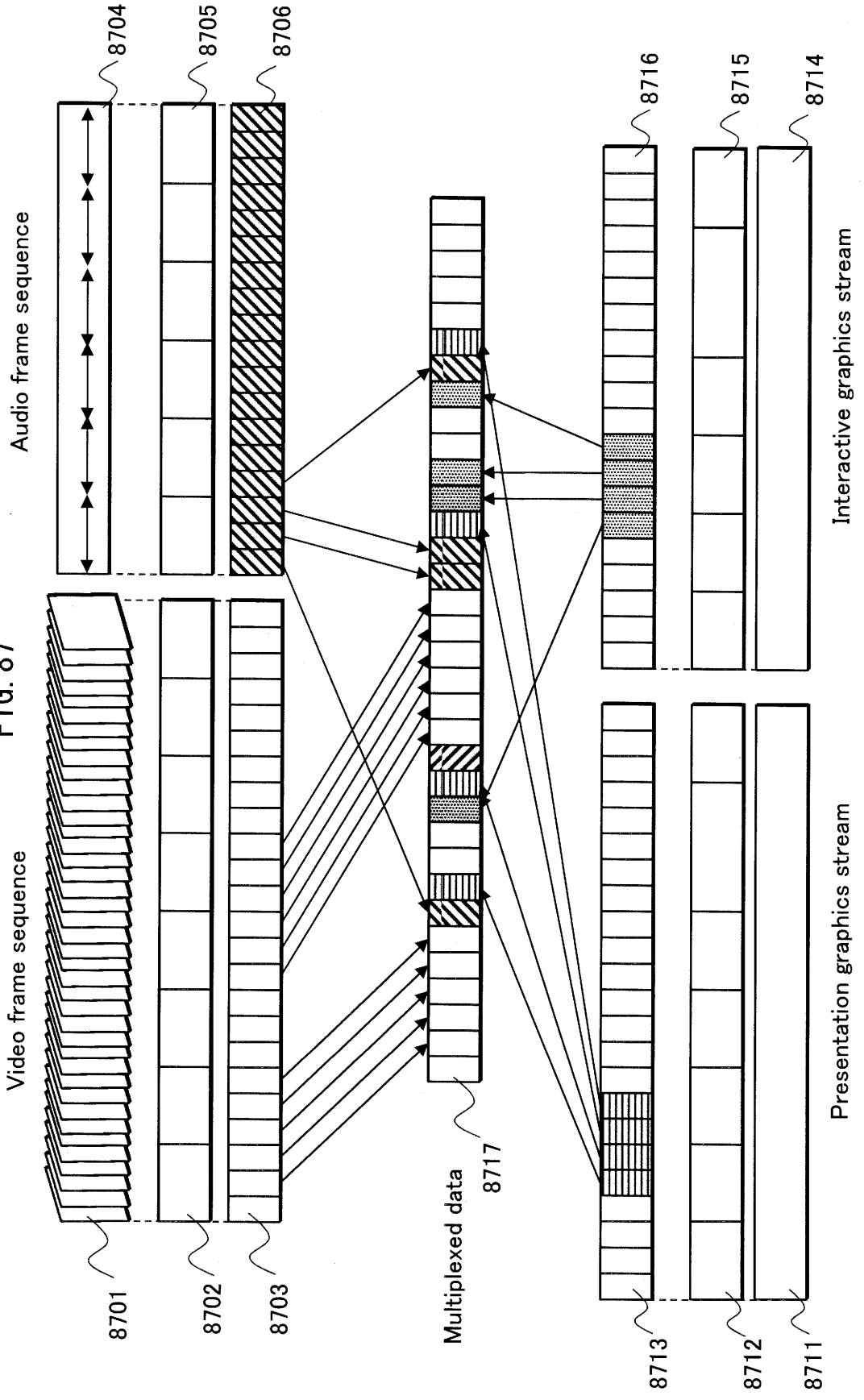

Video frame sequence
Audio frame sequence
Multiplexed data
Interactive graphics stream
Presentation graphics stream
8701
8702
8703
8704
8705
8706
8711
8712
8713
8714
8715
8716
8717

FIG. 88

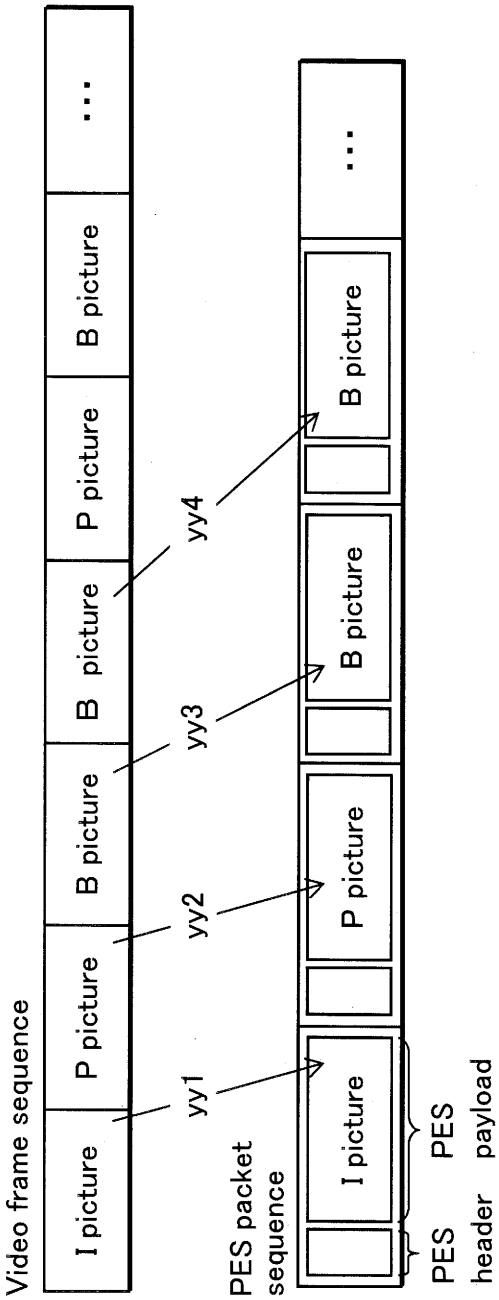

Video frame sequence
I picture
P picture
B picture
B picture
P picture
B picture
...
yy1
yy2
yy3
yy4
PES packet sequence
I picture
P picture
B picture
B picture
...
PES header
PES payload

FIG. 89

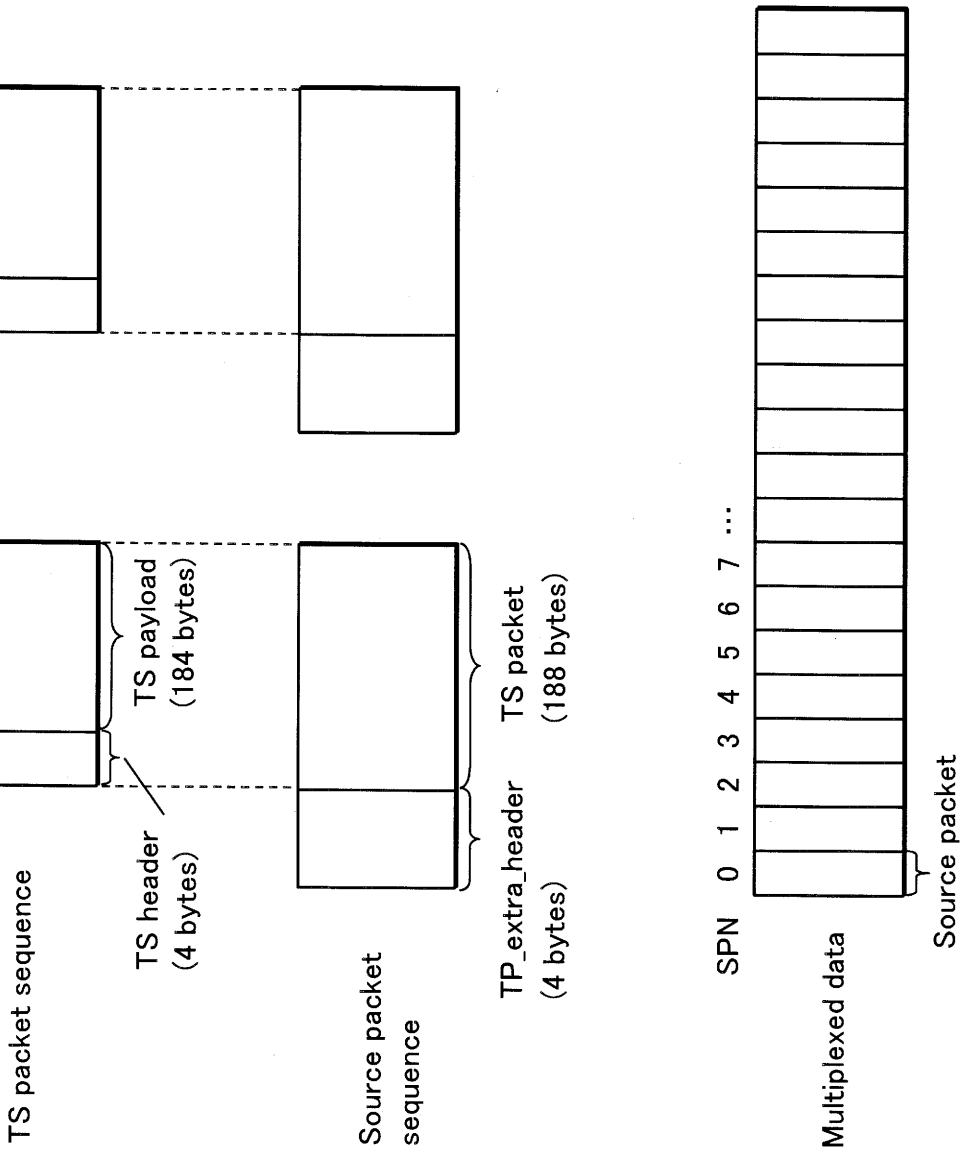

TS packet sequence
TS header
(4 bytes)
TS payload
(184 bytes)
Source packet
sequence
TP_extra_header
(4 bytes)
TS packet
(188 bytes)
SPN 0 1 2 3 4 5 6 7 ...
Multiplexed data
Source packet

FIG. 90

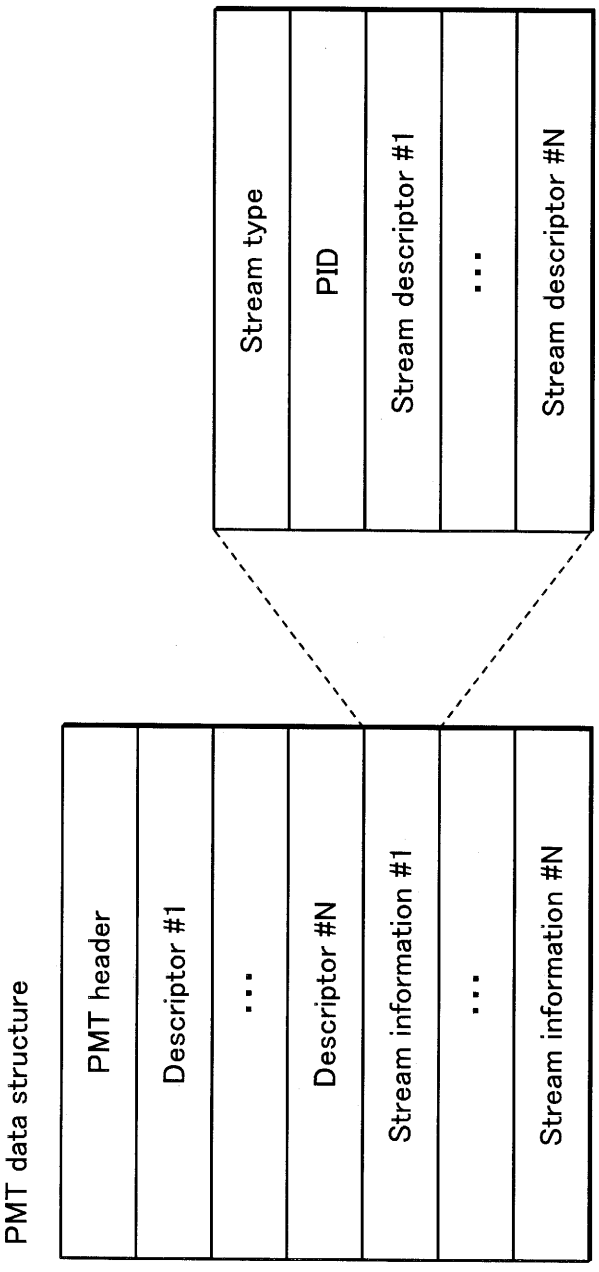

PMT data structure
PMT header
Descriptor #1
...
Descriptor #N
Stream information #1
...
Stream information #N
Stream type
PID
Stream descriptor #1
...
Stream descriptor #N

FIG. 91

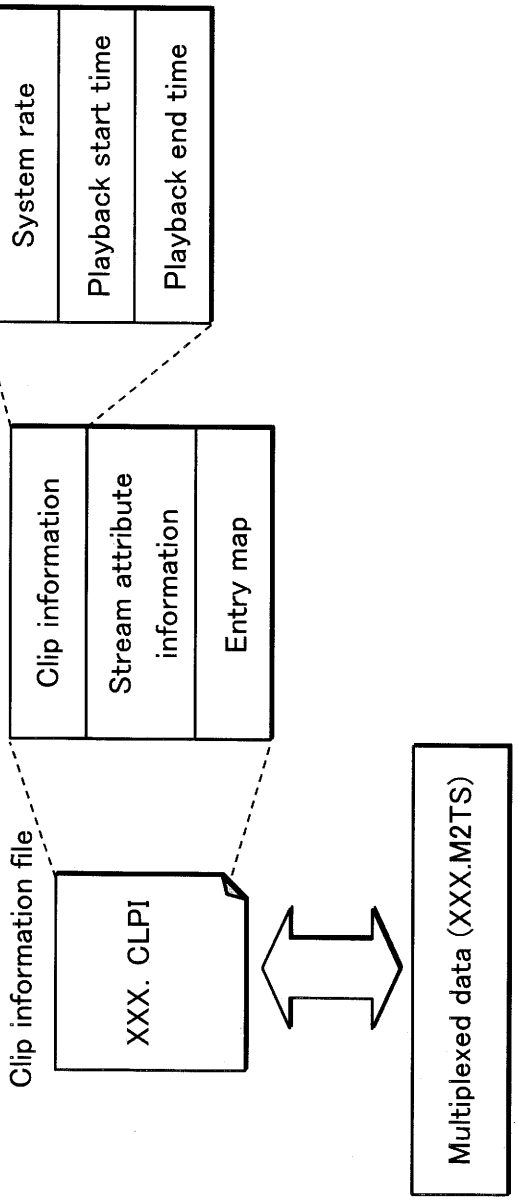

System rate
Playback start time
Playback end time
Clip information
Stream attribute information
Entry map
Clip information file
XXX. CLPI
Multiplexed data (XXX.M2TS)

FIG. 92

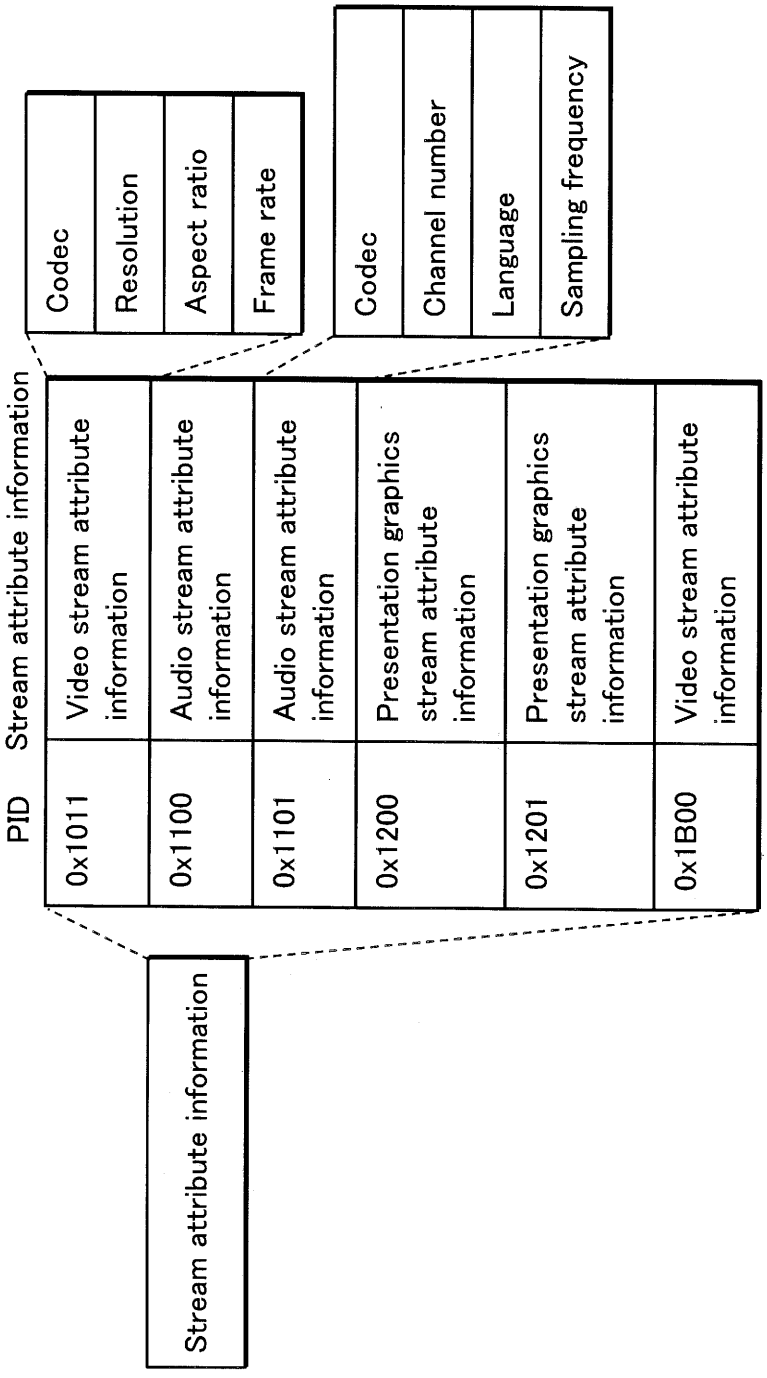

Stream attribute information
PID
Stream attribute information
0x1011
Video stream attribute information
0x1100
Audio stream attribute information
0x1101
Audio stream attribute information
0x1200
Presentation graphics stream attribute information
0x1201
Presentation graphics stream attribute information
0x1B00
Video stream attribute information
Codec
Resolution
Aspect ratio
Frame rate
Codec
Channel number
Language
Sampling frequency

FIG. 93

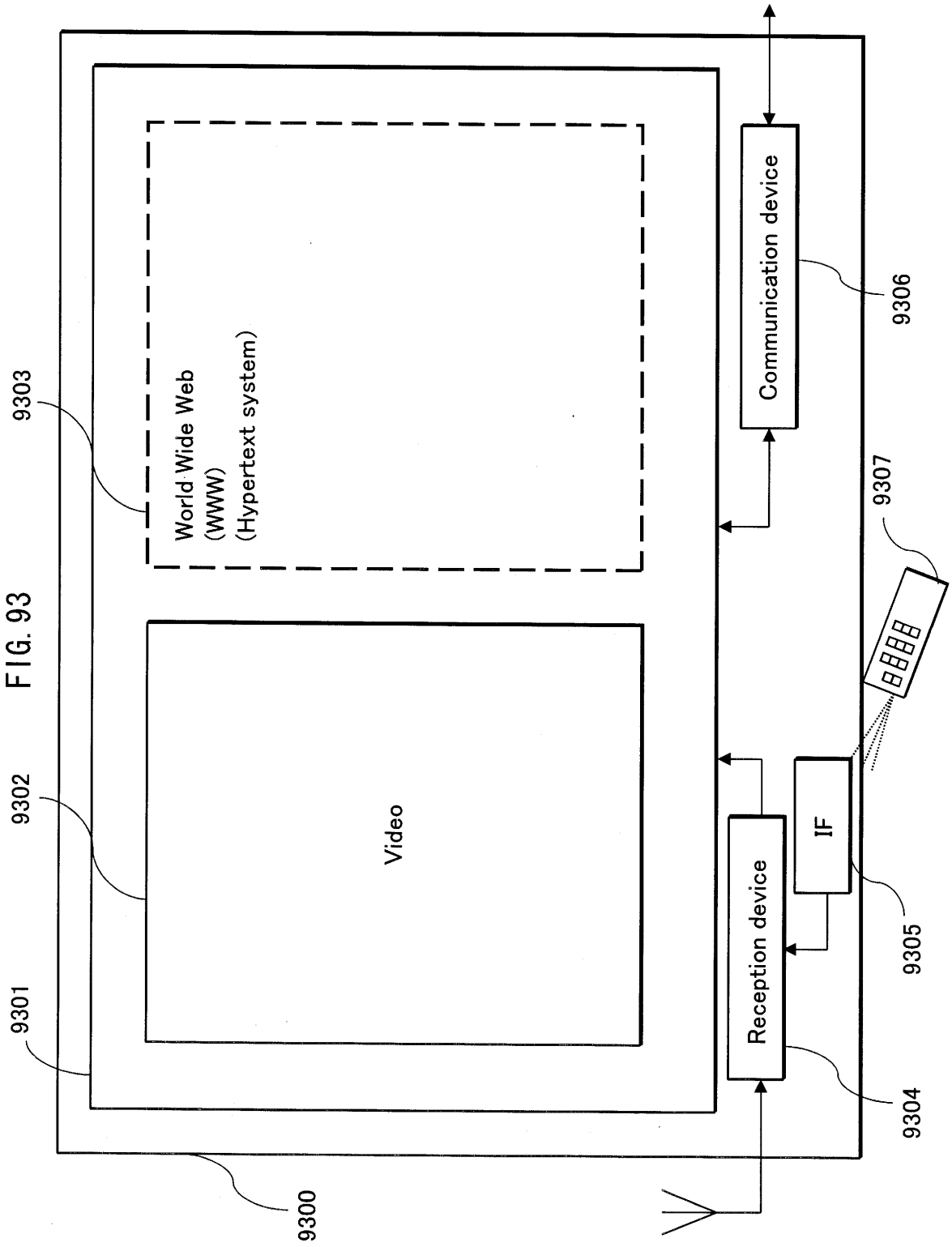

9300
9301
9302
9303
World Wide Web
(WWW)
(Hypertext system)
Video
Communication device
9306
9307
IF
9305
Reception device
9304

FIG. 94

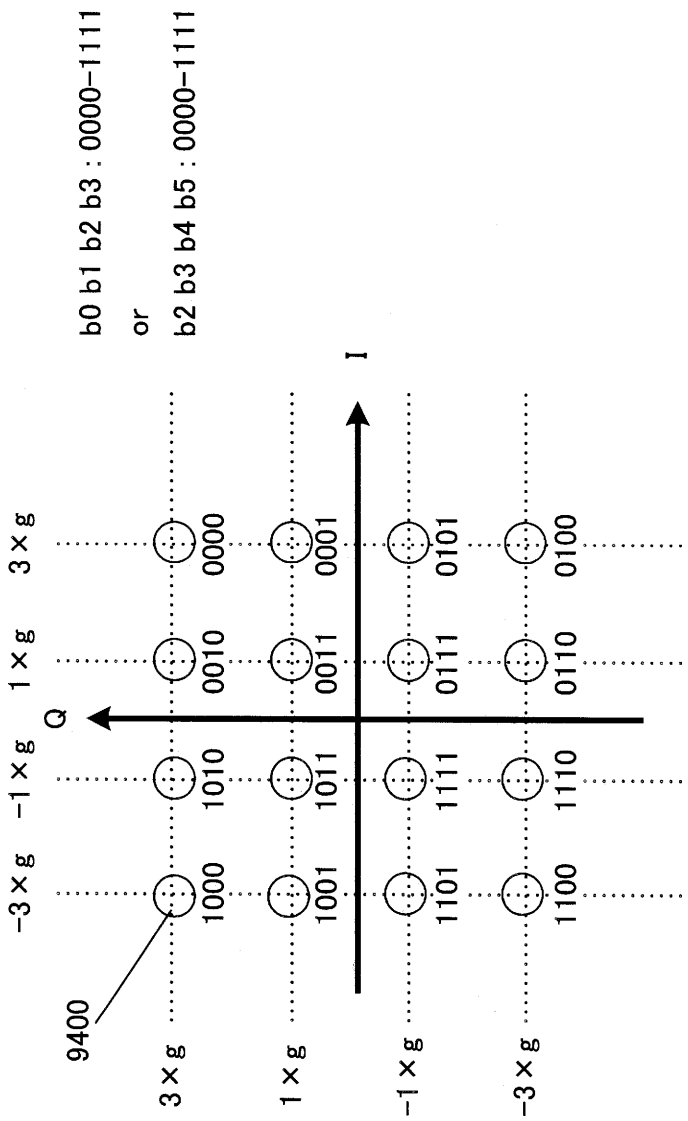

b0 b1 b2 b3 : 0000–1111
or
b2 b3 b4 b5 : 0000–1111
Q
I
−3×g
−1×g
1×g
3×g
9400
1000
1010
0010
0000
1001
1011
0011
0001
1101
1111
0111
0101
1100
1110
0110
0100

FIG. 95

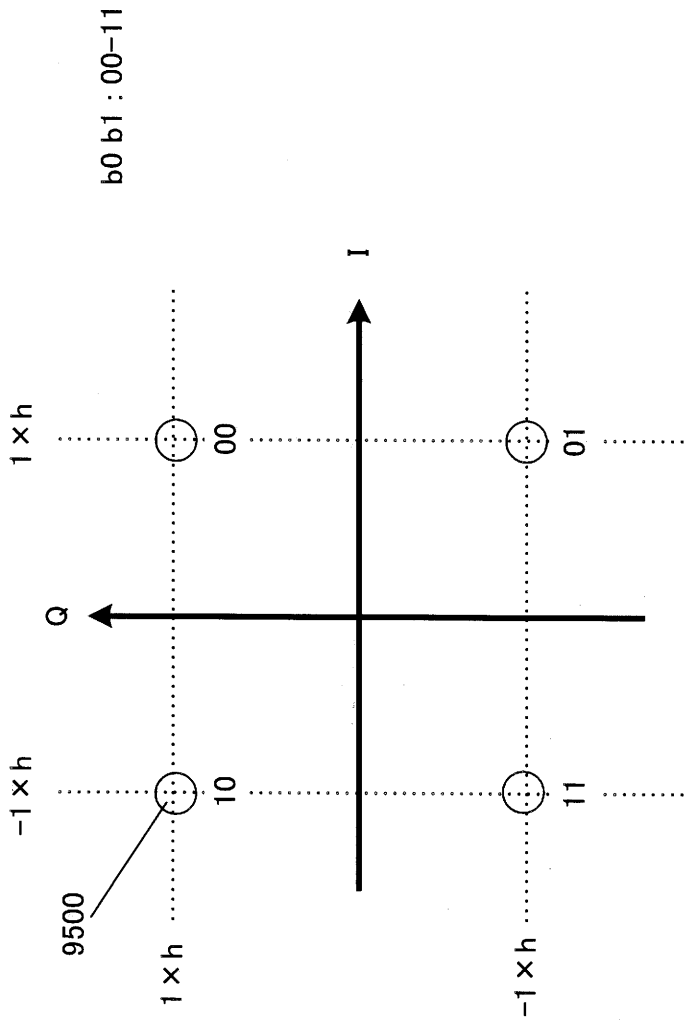


FIG. 96

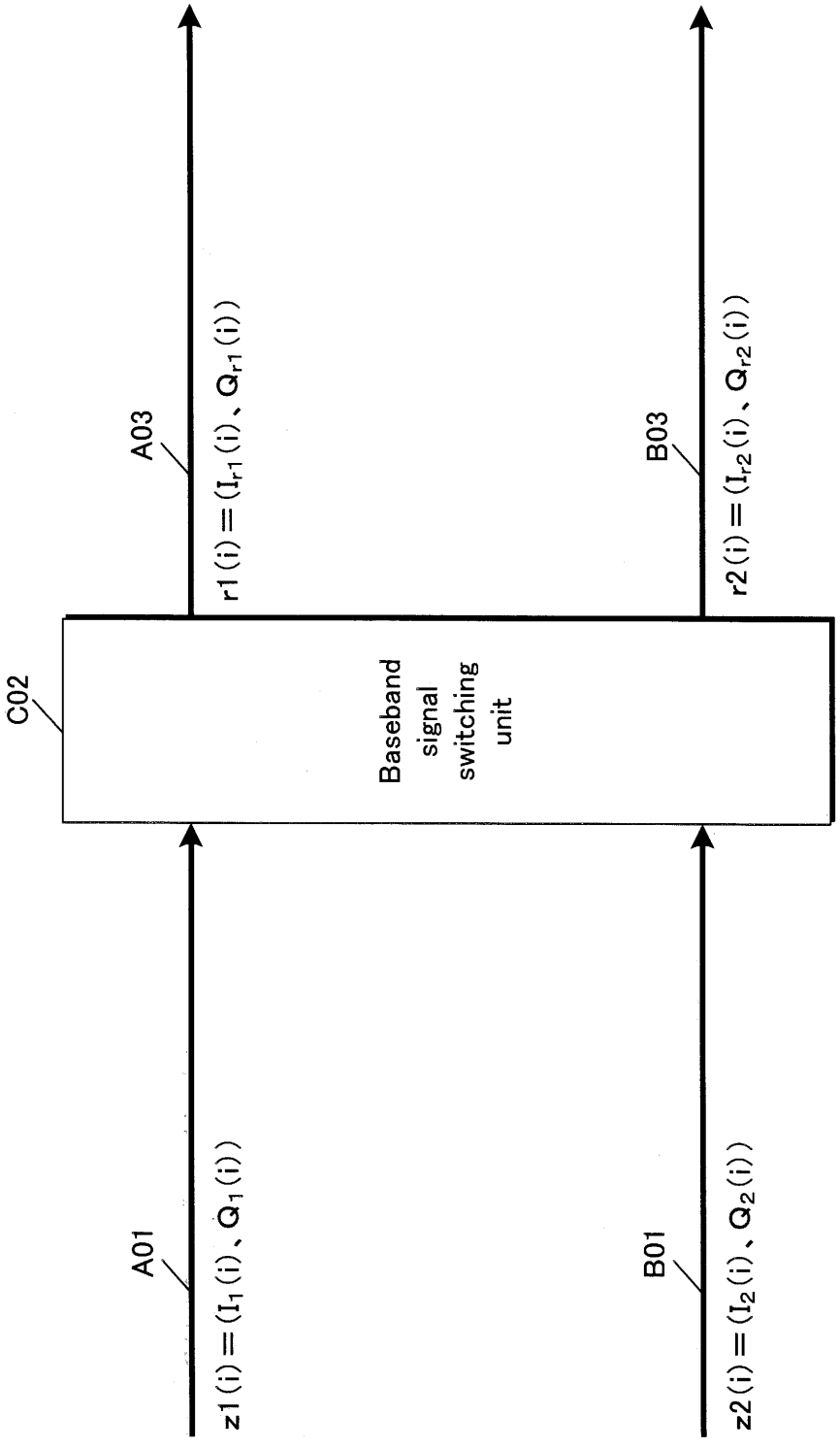

C02
Baseband signal switching unit
A01
z1(i) = (I1(i)、Q1(i))
B01
z2(i) = (I2(i)、Q2(i))
A03
r1(i) = (Ir1(i)、Qr1(i))
B03
r2(i) = (Ir2(i)、Qr2(i))

FIG. 97

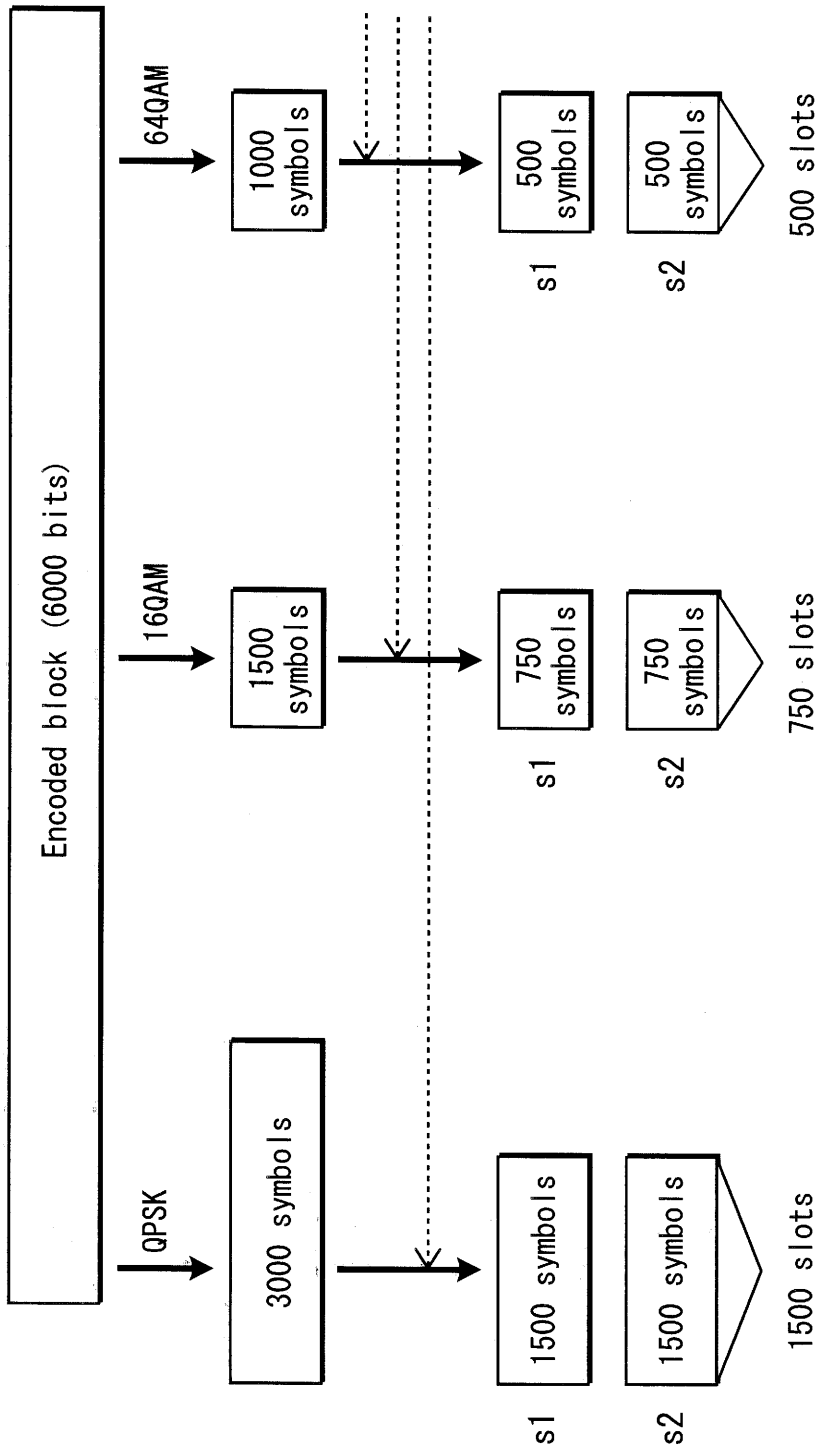

Encoded block (6000 bits)
QPSK
16QAM
64QAM
3000 symbols
1500 symbols
1000 symbols
Encoding by one encoder, two stream transmission
1500 symbols
1500 symbols
750 symbols
750 symbols
500 symbols
500 symbols
s1
s2
1500 slots
750 slots
500 slots

FIG. 98

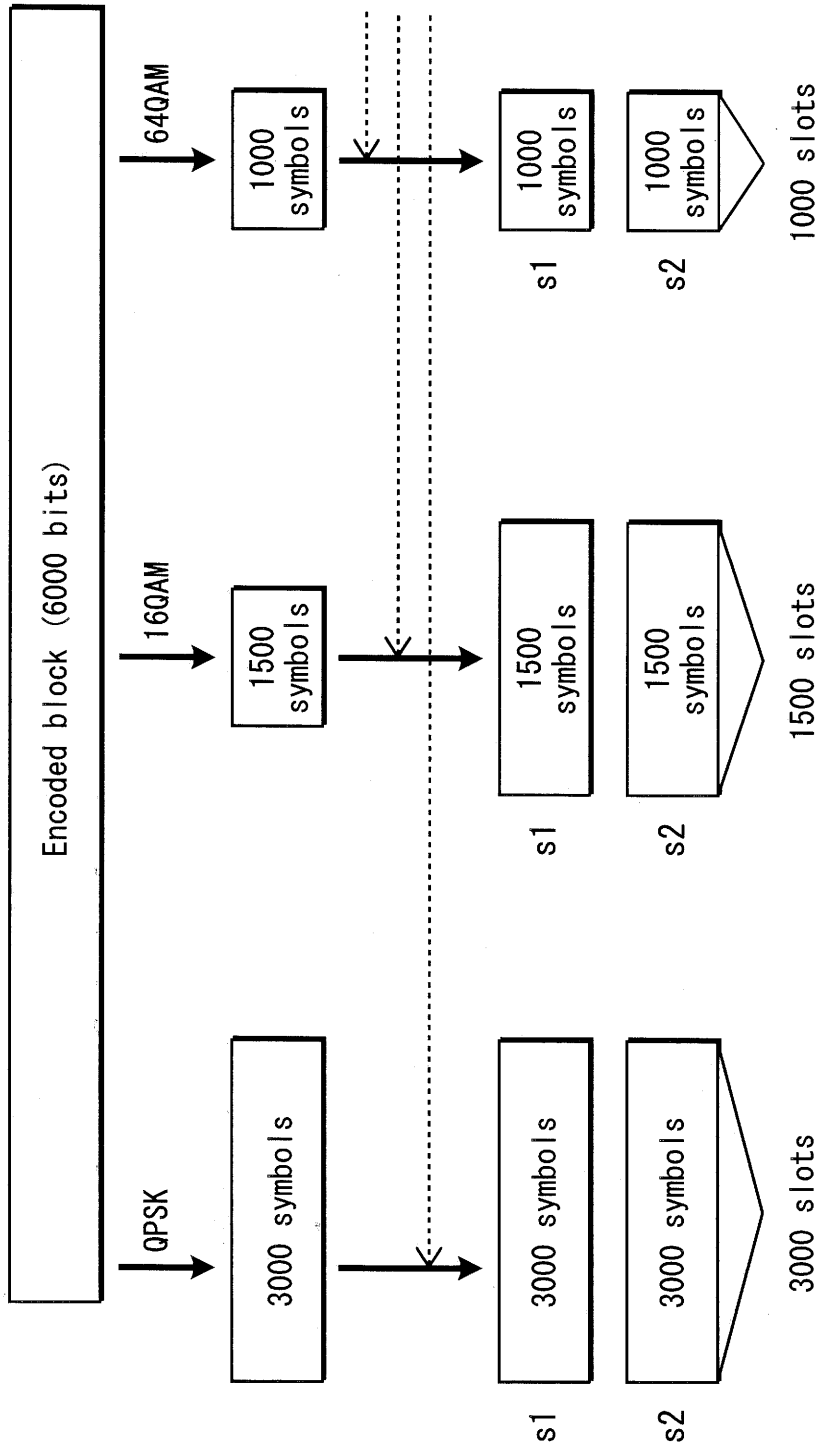

Encoded block (6000 bits)
QPSK
64QAM
16QAM
3000 symbols
1000 symbols
1500 symbols
Encoding by two encoder, two stream transmission
3000 symbols
1000 symbols
1500 symbols
s1
s2
3000 slots
1000 slots
1500 slots

FIG. 99A

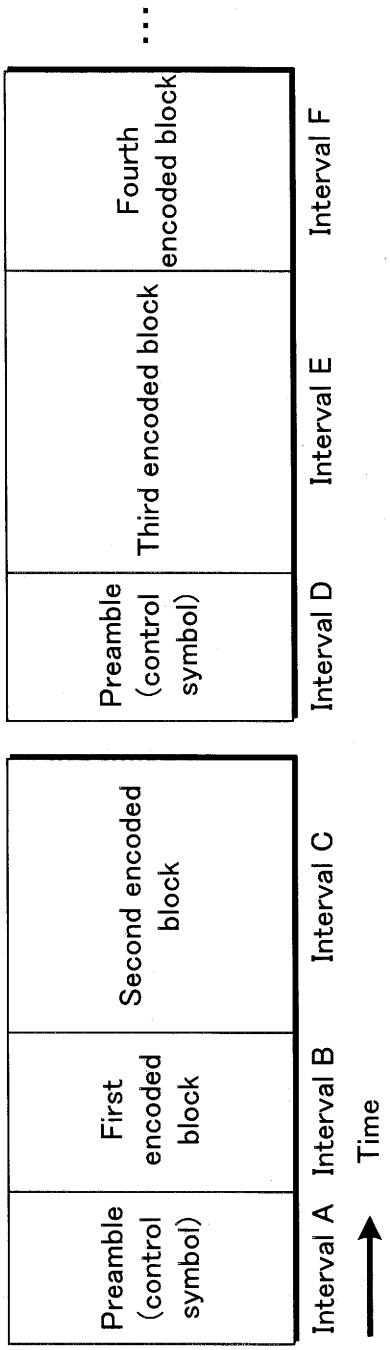


FIG. 99B

FIG. 100

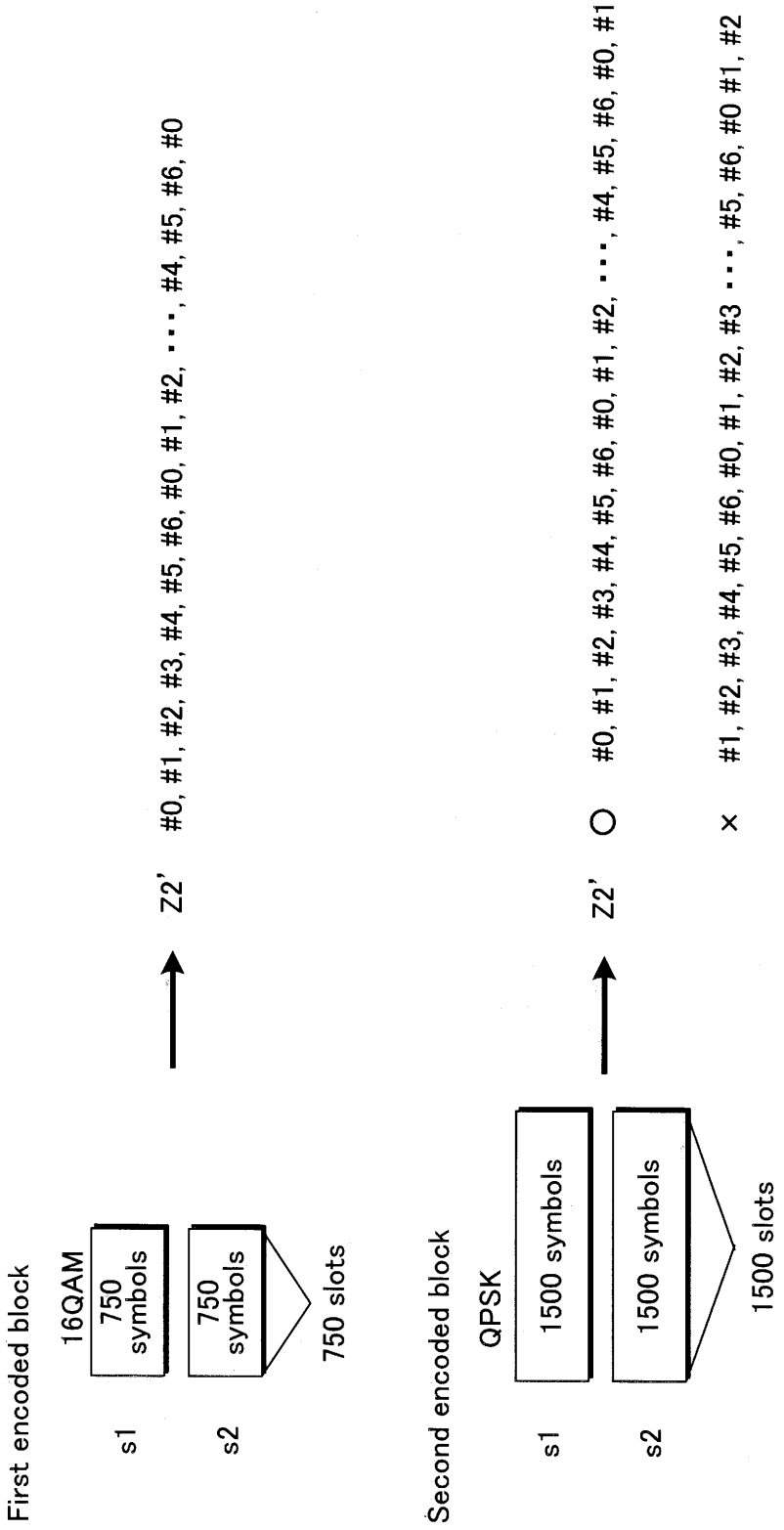

First encoded block
16QAM
s1
750 symbols
s2
750 symbols
750 slots
Z2'
#0, #1, #2, #3, #4, #5, #6, #0, #1, #2, ・・・, #4, #5, #6, #0
Second encoded block
QPSK
s1
1500 symbols
s2
1500 symbols
1500 slots
Z2'
○
#0, #1, #2, #3, #4, #5, #6, #0, #1, #2, ・・・, #4, #5, #6, #0, #1
×
#1, #2, #3, #4, #5, #6, #0, #1, #2, #3 ・・・, #5, #6, #0 #1, #2

FIG. 101

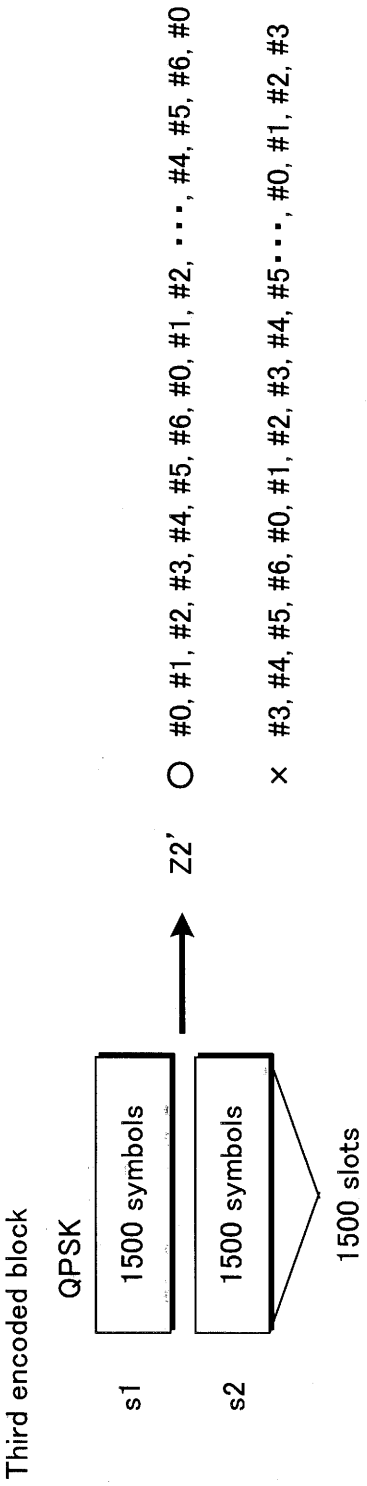

Third encoded block
QPSK
1500 symbols
1500 symbols
1500 slots
s1
s2
Z2'
○ #0, #1, #2, #3, #4, #5, #6, #0, #1, #2, ･･･, #4, #5, #6, #0
× #3, #4, #5, #6, #0, #1, #2, #3, #4, #5･･･, #0, #1, #2, #3

FIG. 102

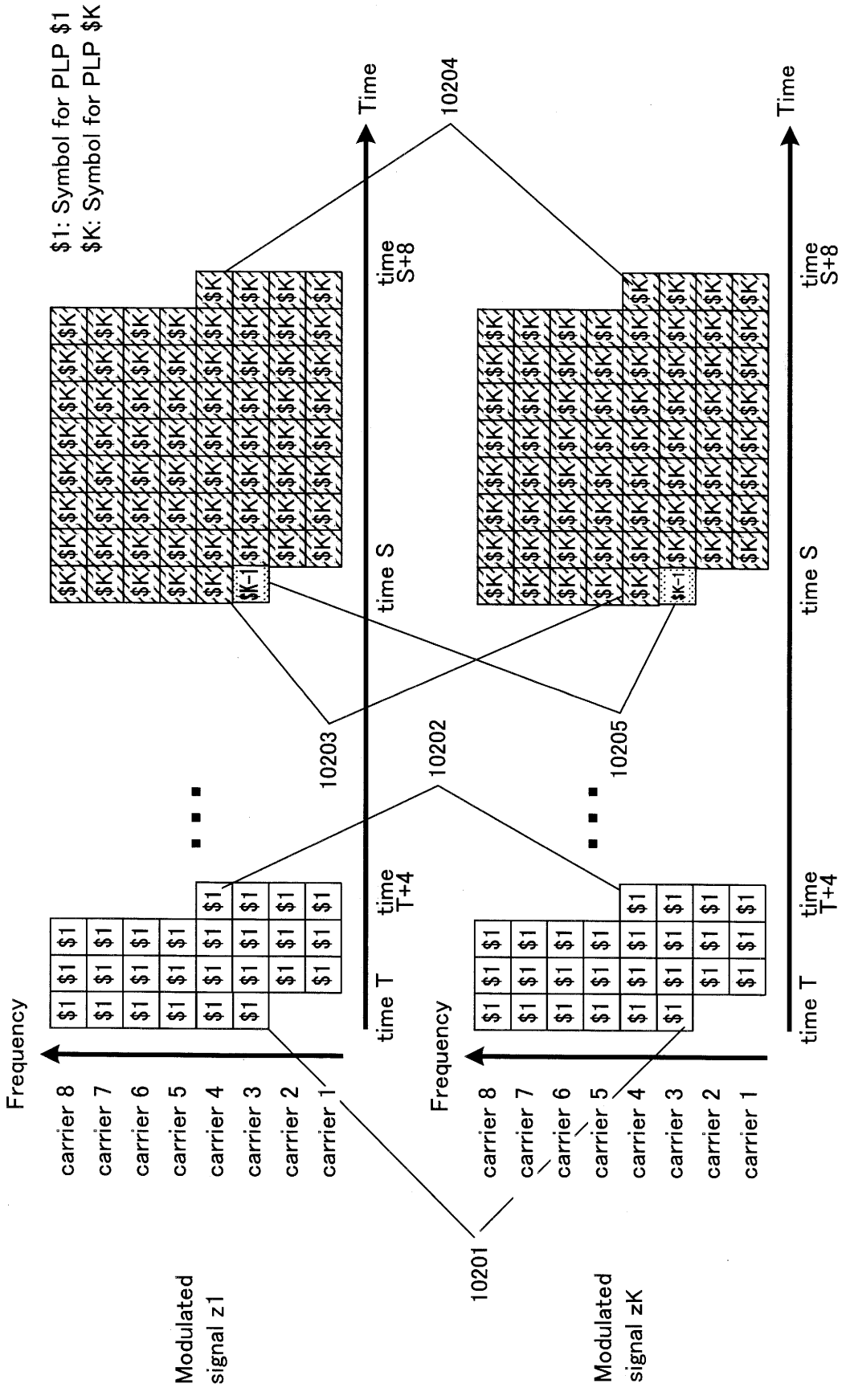

$1: Symbol for PLP $1
$K: Symbol for PLP $K
Modulated signal z1
Modulated signal zK
Frequency
carrier 8
carrier 7
carrier 6
carrier 5
carrier 4
carrier 3
carrier 2
carrier 1
time T
time T+4
time S
time S+8
Time
10201
10202
10203
10204
10205

FIG. 103

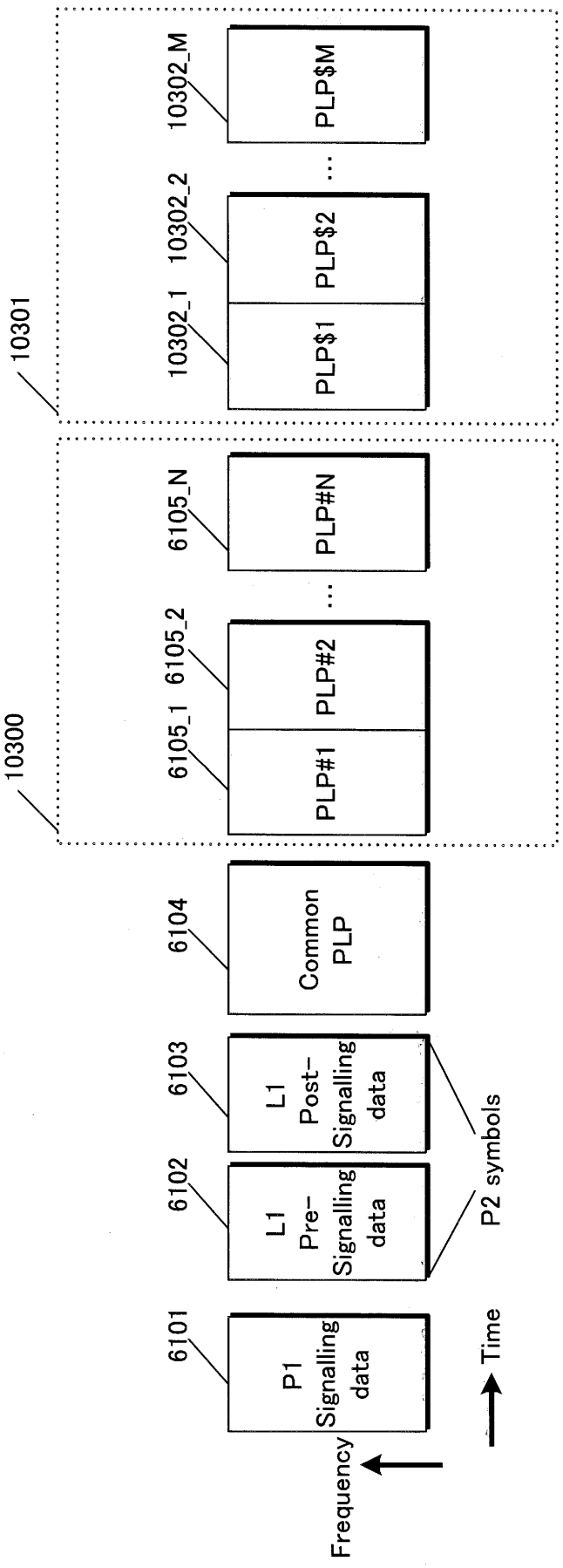

10301
10302_M
PLP$M
10302_2
PLP$2
10302_1
PLP$1
10300
6105_N
PLP#N
6105_2
PLP#2
6105_1
PLP#1
6104
Common PLP
6103
L1 Post-Signalling data
6102
L1 Pre-Signalling data
6101
P1 Signalling data
P2 symbols
Time
Frequency

FIG. 104

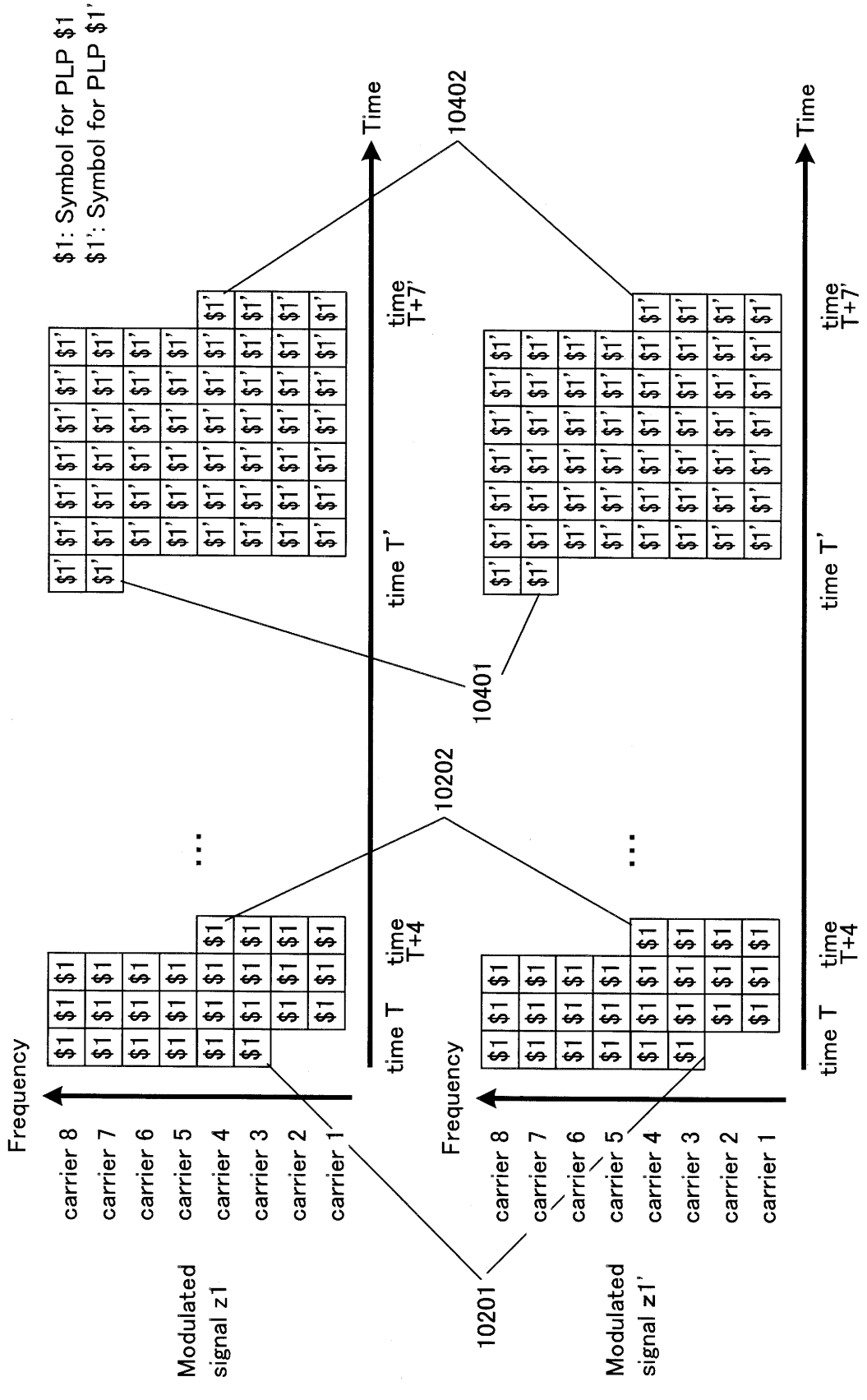

$1: Symbol for PLP $1
$1': Symbol for PLP $1'
Time
time T'
time T+7'
10402
10401
10202
10201
Frequency
carrier 8
carrier 7
carrier 6
carrier 5
carrier 4
carrier 3
carrier 2
carrier 1
Modulated signal z1
Modulated signal z1'
time T
time T+4

FIG. 105

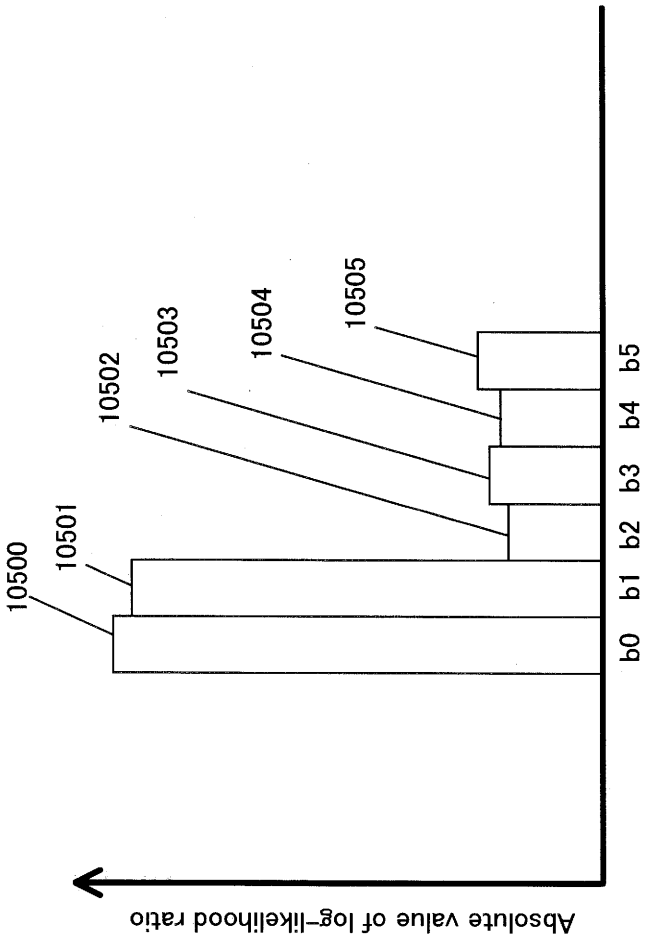

10500
10501
10502
10503
10504
10505
b0
b1
b2
b3
b4
b5
Absolute value of log-likelihood ratio

FIG. 106

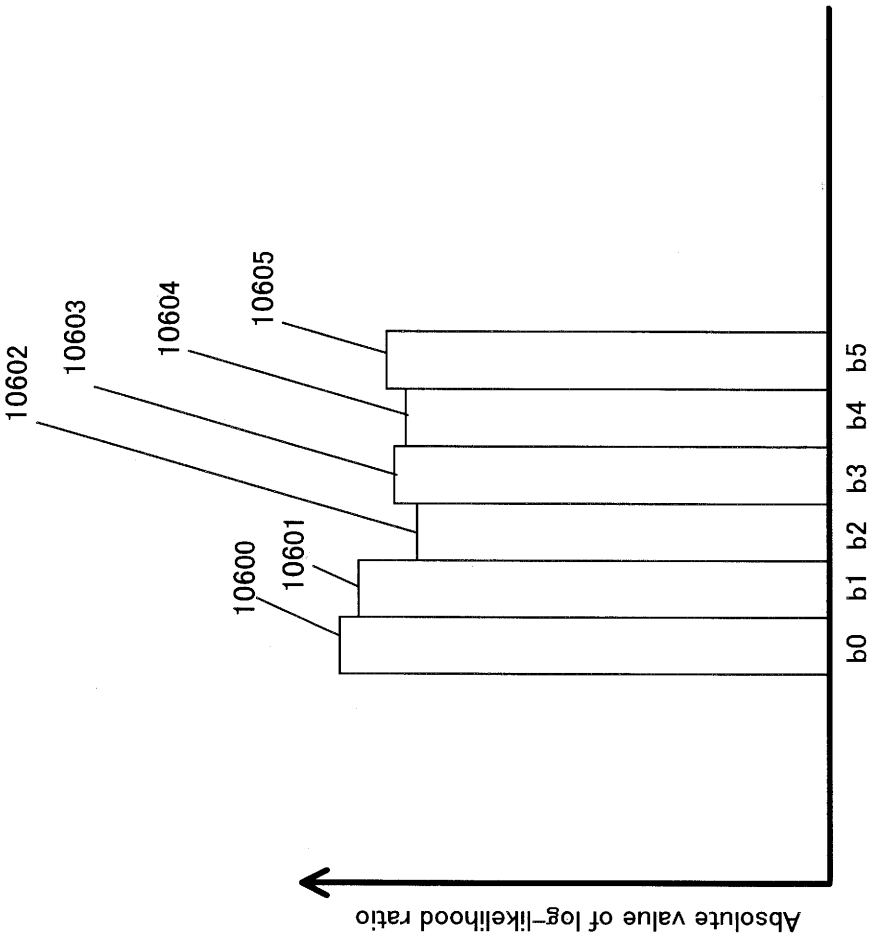

10602
10603
10604
10605
10600
10601
b0
b1
b2
b3
b4
b5
Absolute value of log-likelihood ratio

FIG. 107

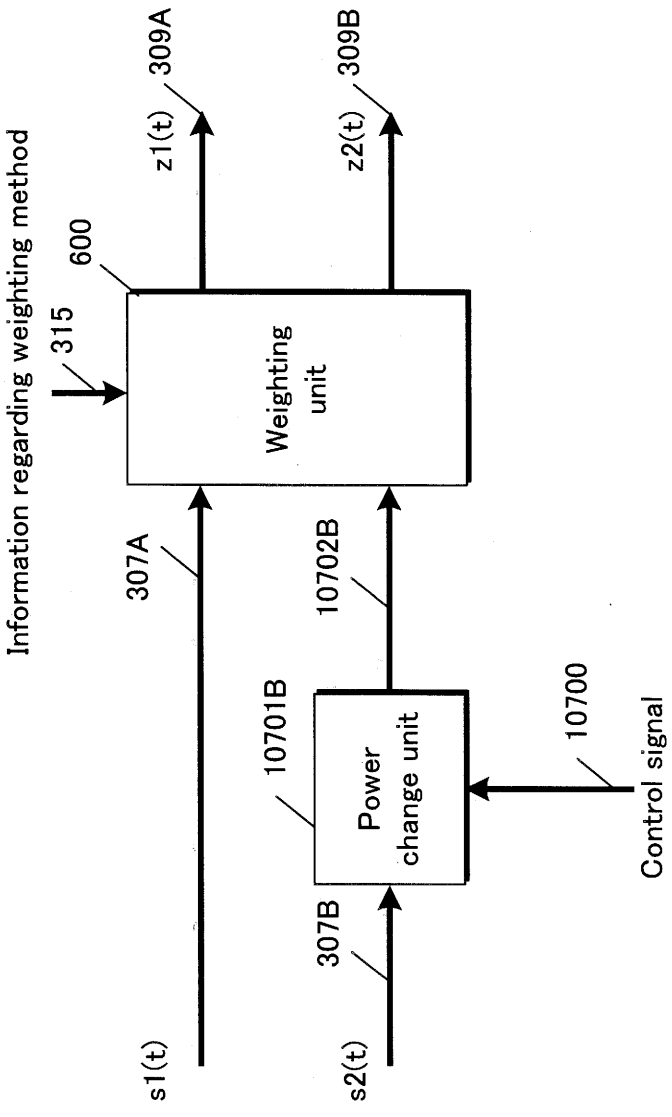

Information regarding weighting method
315
600
Weighting unit
z1(t)
309A
z2(t)
309B
307A
10702B
10701B
Power change unit
10700
Control signal
307B
s1(t)
s2(t)

FIG. 108

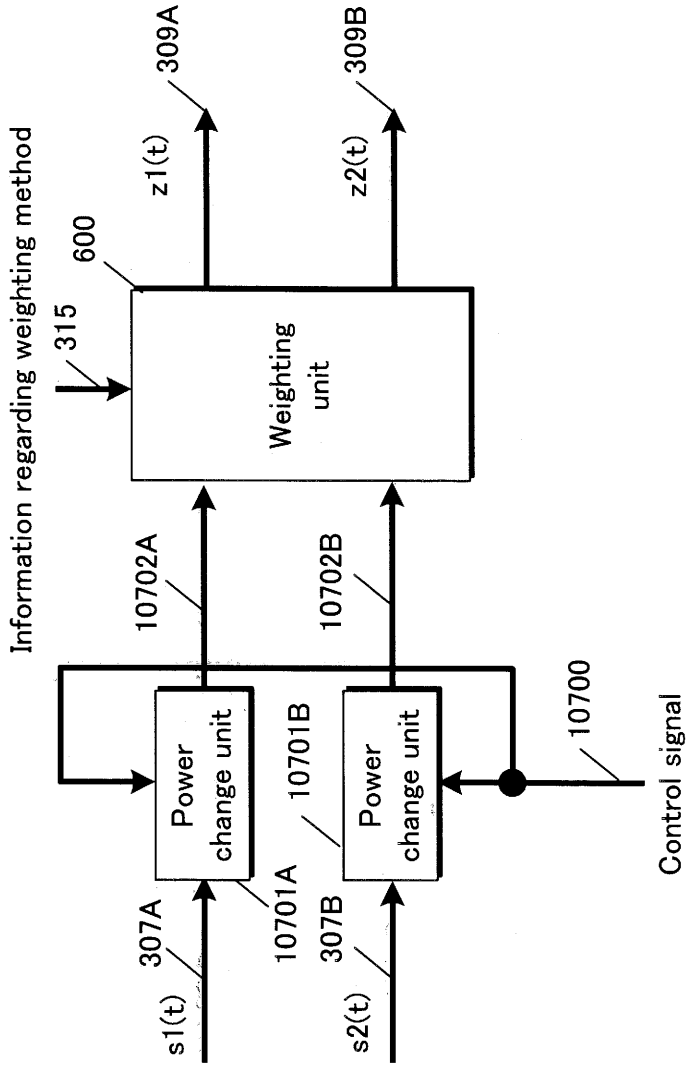

Information regarding weighting method
315
600
Weighting unit
z1(t)
309A
z2(t)
309B
10702A
10702B
Power change unit
Power change unit
10701A
10701B
10700
Control signal
307A
s1(t)
307B
s2(t)

FIG. 109

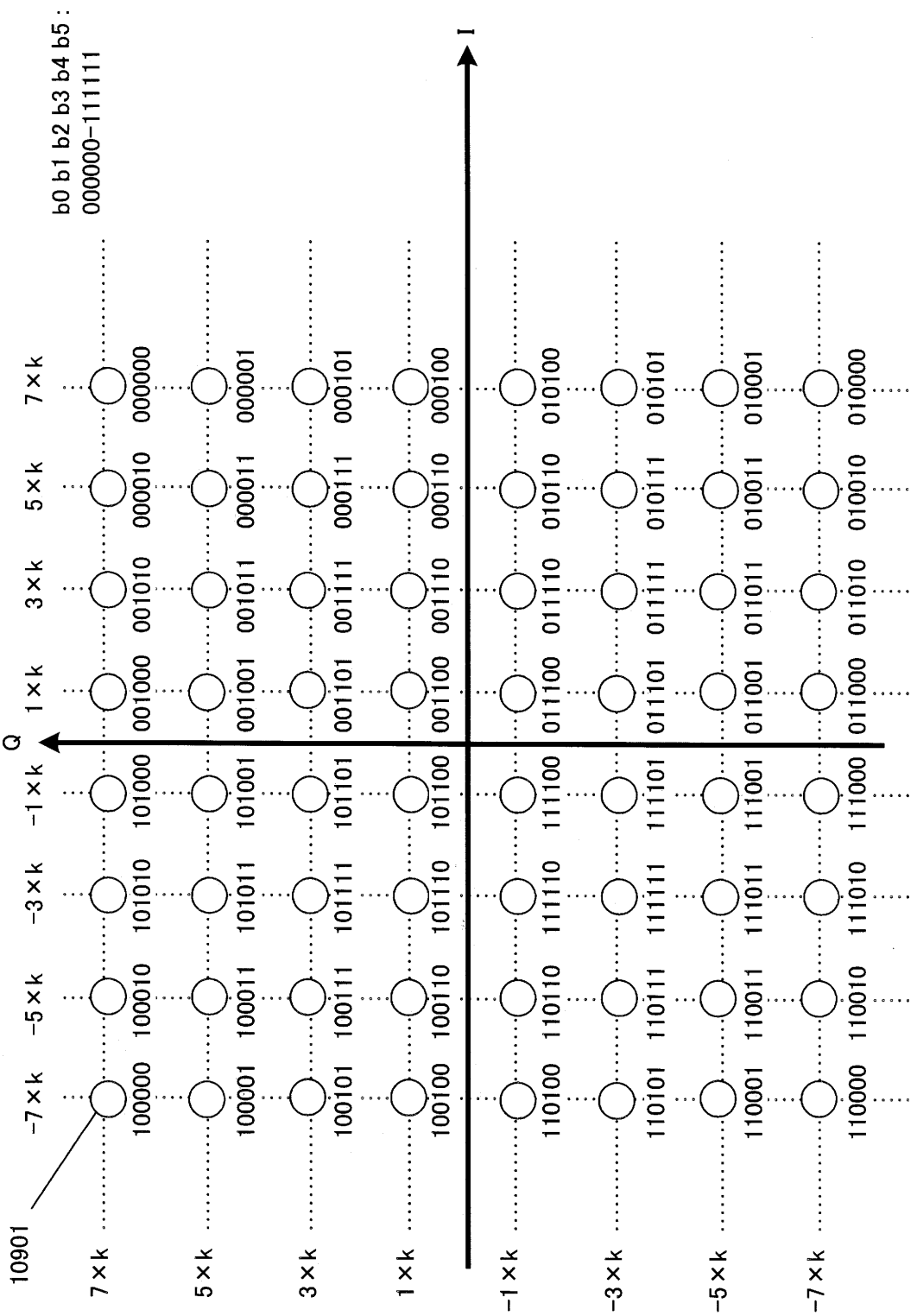

Q
I
b0 b1 b2 b3 b4 b5 :
000000–111111
10901
−7×k
−5×k
−3×k
−1×k
1×k
3×k
5×k
7×k
100000 100010 101010 101000 001000 001010 000010 000000
100001 100011 101011 101001 001001 001011 000011 000001
100101 100111 101111 101101 001101 001111 000111 000101
100100 100110 101110 101100 001100 001110 000110 000100
110100 110110 111110 111100 011100 011110 010110 010100
110101 110111 111111 111101 011101 011111 010111 010101
110001 110011 111011 111001 011001 011011 010011 010001
110000 110010 111010 111000 011000 011010 010010 010000

FIG. 110

Cycle of precoding matrices: 3

s1(t)	QPSK	QPSK	QPSK	16QAM	16QAM	16QAM	QPSK	QPSK	QPSK	16QAM	16QAM	16QAM	...
s2(t)	16QAM	16QAM	16QAM	QPSK	QPSK	QPSK	16QAM	16QAM	16QAM	QPSK	QPSK	QPSK	...
Power change unit (10701A)	v=a	v=a	v=a	v=b	v=b	v=b	v=a	v=a	v=a	v=b	v=b	v=b	...
Power change unit (10701B)	u=b	u=b	u=b	u=a	u=a	u=a	u=b	u=b	u=b	u=a	u=a	u=a	...
Precoding matrix	F[0]	F[1]	F[2]	F[0]	F[1]	F[2]	F[0]	F[1]	F[2]	F[0]	F[1]	F[2]	...
Time (Frequency)	t=0 (f=f0)	t=1 (f=f1)	t=2 (f=f2)	t=3 (f=f3)	t=4 (f=f4)	t=5 (f=f5)	t=6 (f=f6)	t=7 (f=f7)	t=8 (f=f8)	t=9 (f=f9)	t=10 (f=f10)	t=11 (f=f11)	...

Cycle of precoding matrices: 6=3 × 2
(when taking precoding matrices and switching between modulation schemes into consideration)

FIG. 111

Cycle of precoding matrices: 3

s1(t)	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	・・・
s2(t)	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	・・・
Power change unit (10701A)	v=a	v=b	v=a	v=b	v=a	v=b	v=a	v=b	v=a	v=b	v=a	v=b	・・・
Power change unit (10701B)	u=b	u=a	u=b	u=a	u=b	u=a	u=b	u=a	u=b	u=a	u=b	u=a	・・・
Precoding matrix	F[0]	F[1]	F[2]	F[0]	F[1]	F[2]	F[0]	F[1]	F[2]	F[0]	F[1]	F[2]	・・・
Time (Frequency)	t=0 (f=f0)	t=1 (f=f1)	t=2 (f=f2)	t=3 (f=f3)	t=4 (f=f4)	t=5 (f=f5)	t=6 (f=f6)	t=7 (f=f7)	t=8 (f=f8)	t=9 (f=f9)	t=10 (f=f10)	t=11 (f=f11)	・・・

Cycle of precoding matrices: 6=3×2
(when taking precoding matrices and switching between modulation schemes into consideration)

FIG. 112

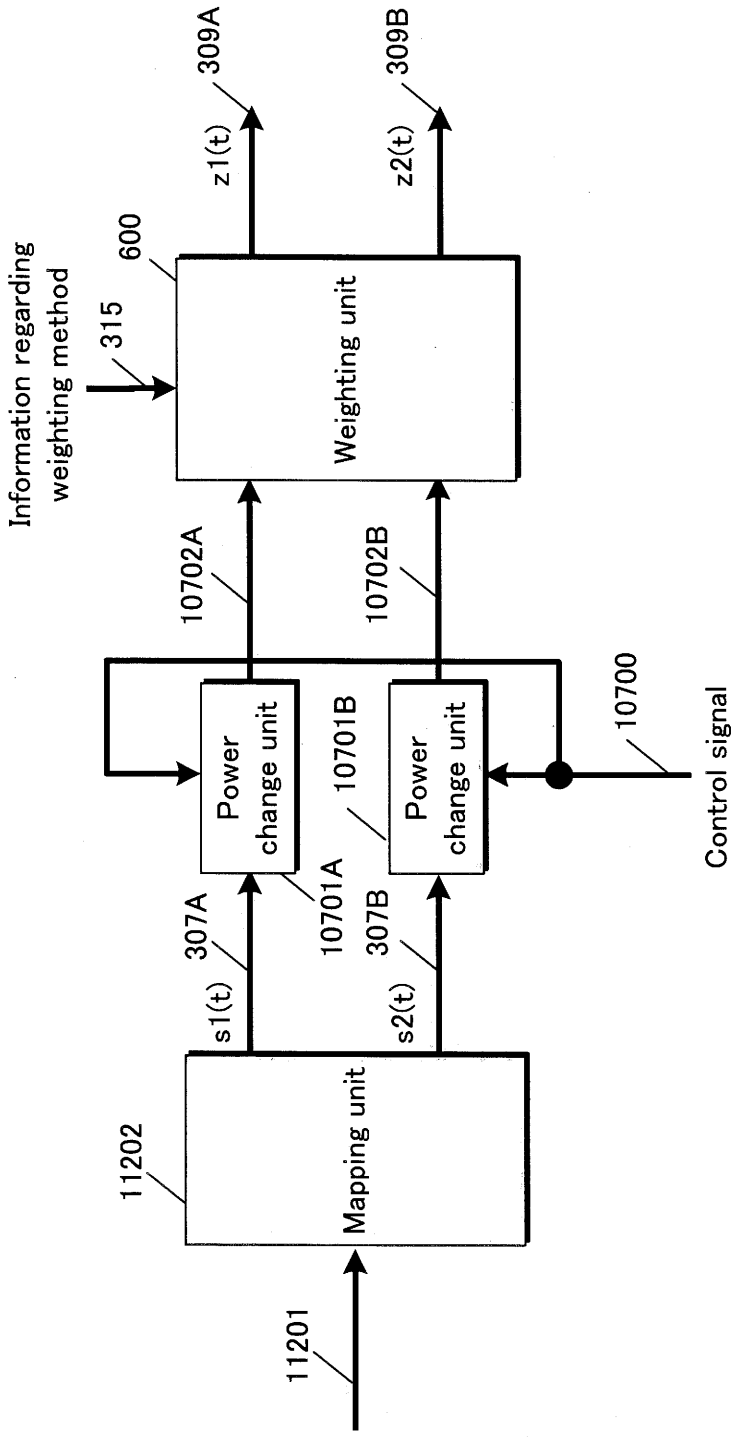

11201
Mapping unit
11202
s1(t)
307A
s2(t)
307B
Power change unit
10701A
Power change unit
10701B
10702A
10702B
10700
Control signal
Information regarding weighting method
315
Weighting unit
600
z1(t)
309A
z2(t)
309B

FIG. 113

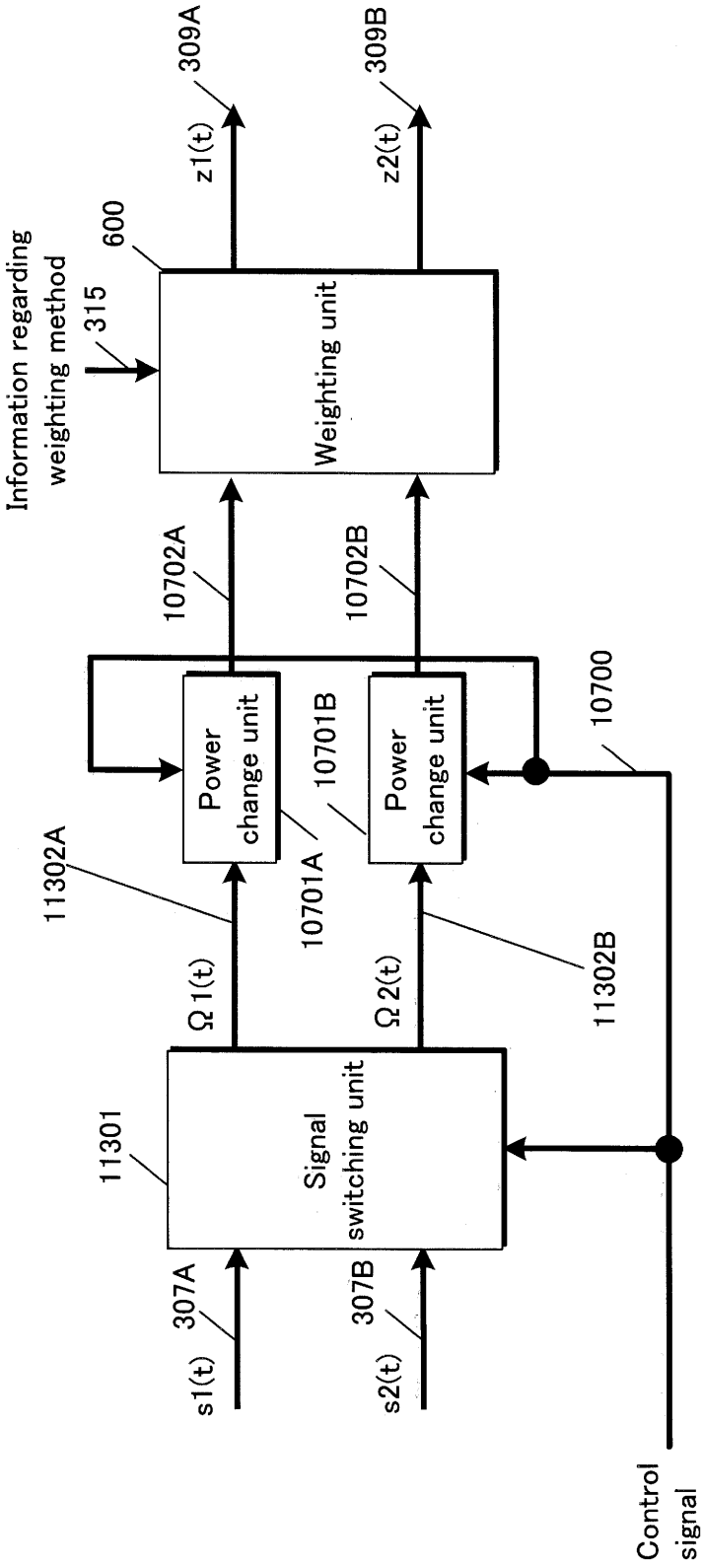

309A
309B
z1(t)
z2(t)
600
Information regarding weighting method
315
Weighting unit
10702A
10702B
Power change unit
Power change unit
10701A
10701B
10700
11302A
11302B
Ω1(t)
Ω2(t)
11301
Signal switching unit
307A
307B
s1(t)
s2(t)
Control signal

FIG. 114

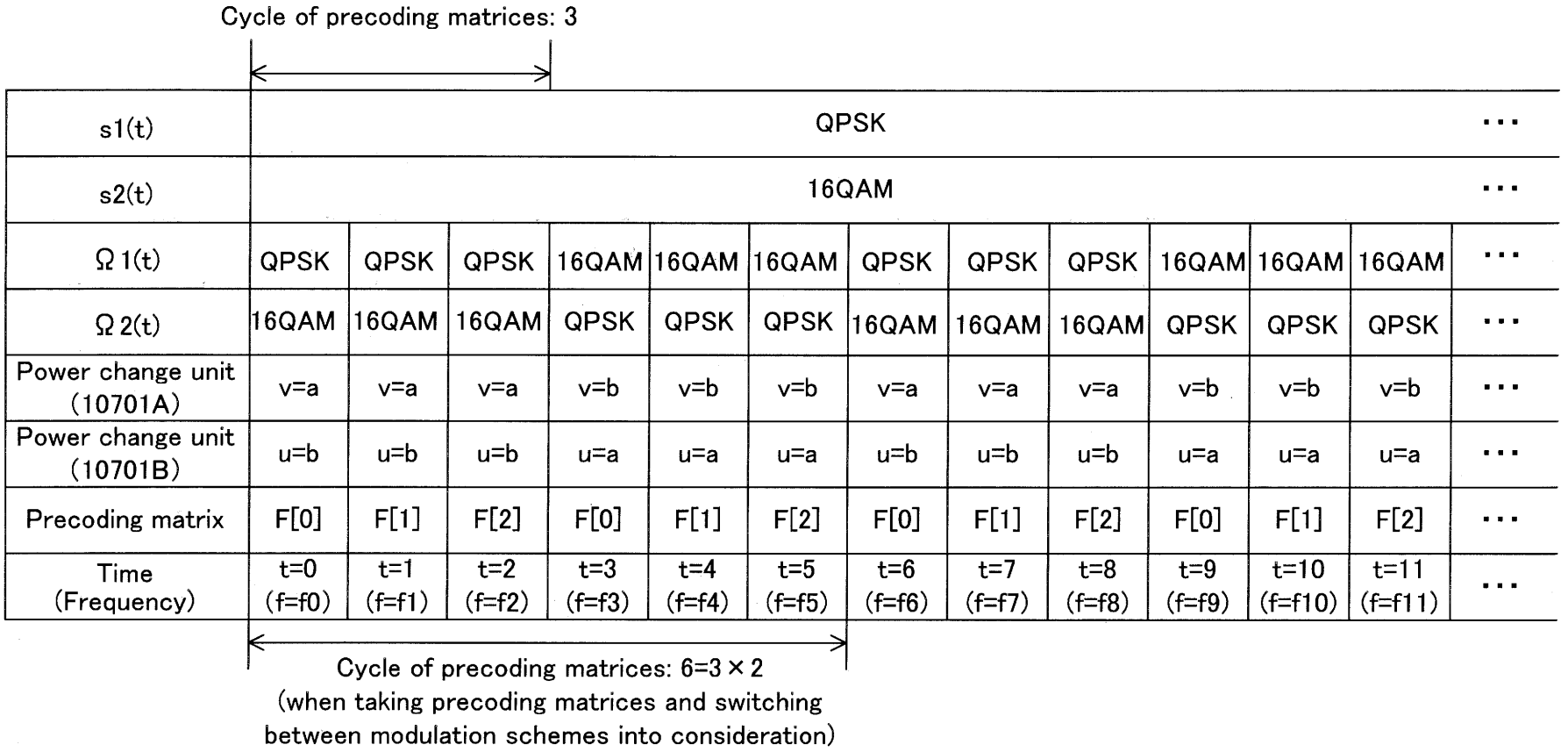

Cycle of precoding matrices: 3
s1(t)
QPSK
s2(t)
16QAM
Ω1(t)
Ω2(t)
Power change unit (10701A)
Power change unit (10701B)
Precoding matrix
Time (Frequency)
t=0 (f=f0)
t=1 (f=f1)
t=2 (f=f2)
t=3 (f=f3)
t=4 (f=f4)
t=5 (f=f5)
t=6 (f=f6)
t=7 (f=f7)
t=8 (f=f8)
t=9 (f=f9)
t=10 (f=f10)
t=11 (f=f11)
Cycle of precoding matrices: 6=3×2
(when taking precoding matrices and switching between modulation schemes into consideration)

FIG. 115

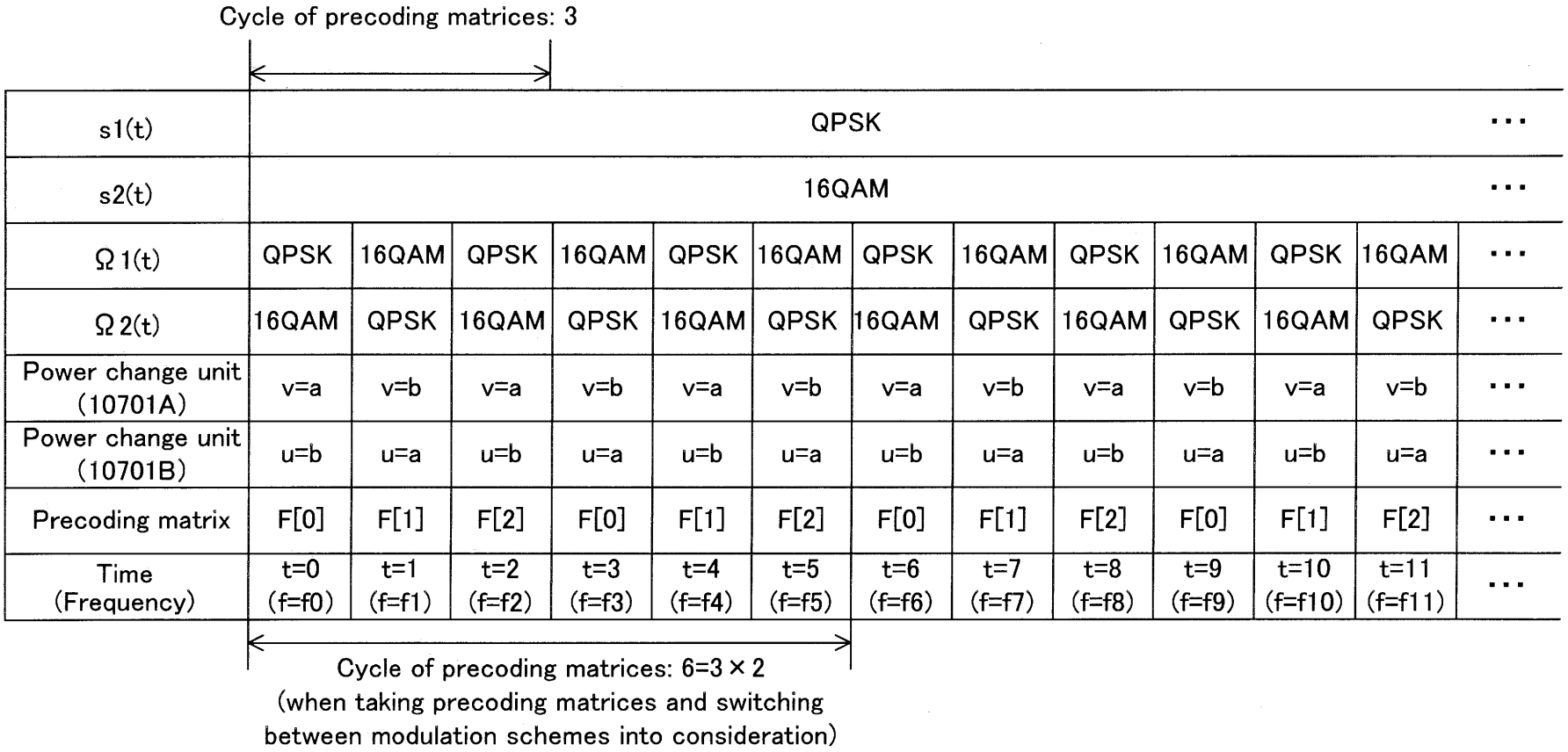

Cycle of precoding matrices: 3
s1(t)
QPSK
s2(t)
16QAM
Ω1(t)
Ω2(t)
Power change unit (10701A)
Power change unit (10701B)
Precoding matrix
Time (Frequency)
t=0 (f=f0)
t=1 (f=f1)
t=2 (f=f2)
t=3 (f=f3)
t=4 (f=f4)
t=5 (f=f5)
t=6 (f=f6)
t=7 (f=f7)
t=8 (f=f8)
t=9 (f=f9)
t=10 (f=f10)
t=11 (f=f11)
Cycle of precoding matrices: 6=3×2
(when taking precoding matrices and switching between modulation schemes into consideration)

FIG. 116

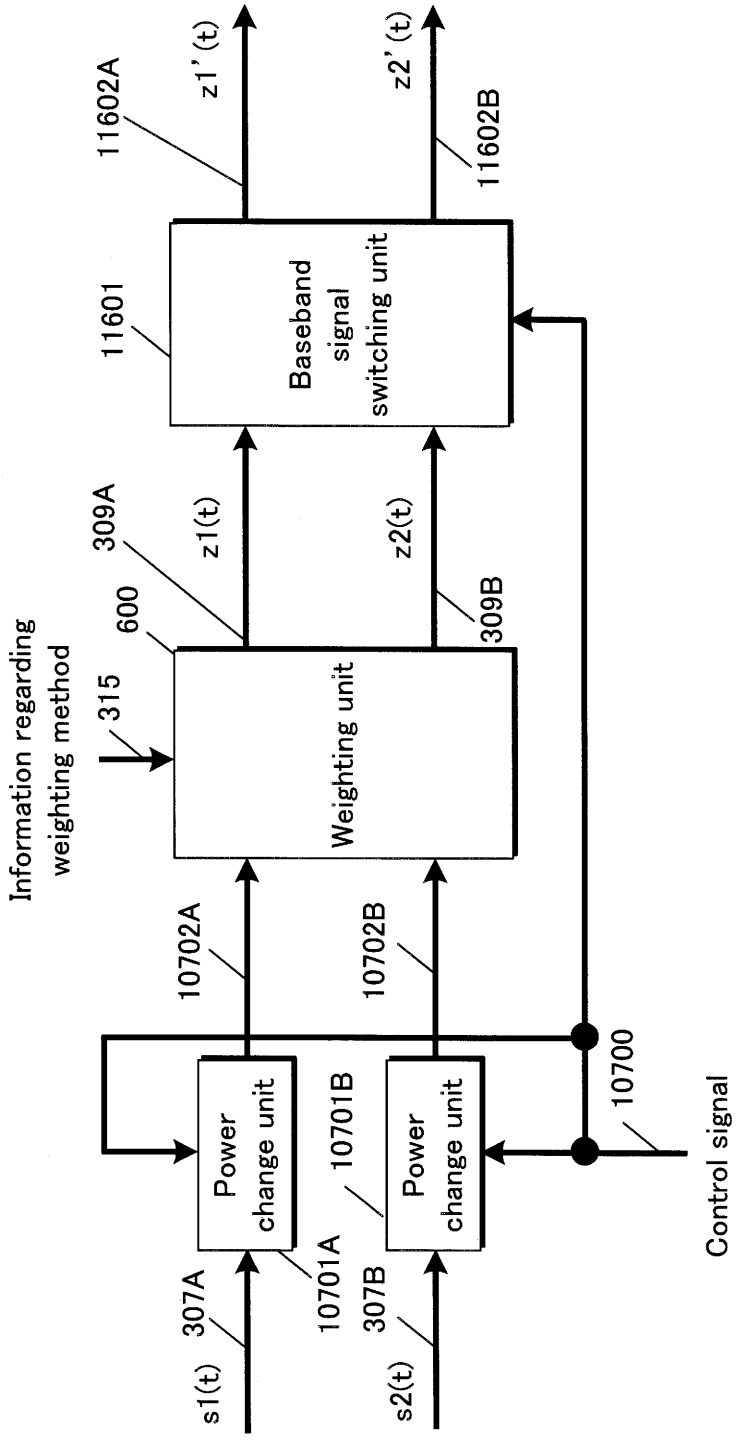

s1(t)
307A
s2(t)
307B
Power change unit
10701A
Power change unit
10701B
10702A
10702B
Information regarding weighting method
315
600
Weighting unit
309A
z1(t)
309B
z2(t)
11601
Baseband signal switching unit
11602A
z1'(t)
11602B
z2'(t)
10700
Control signal

FIG. 117

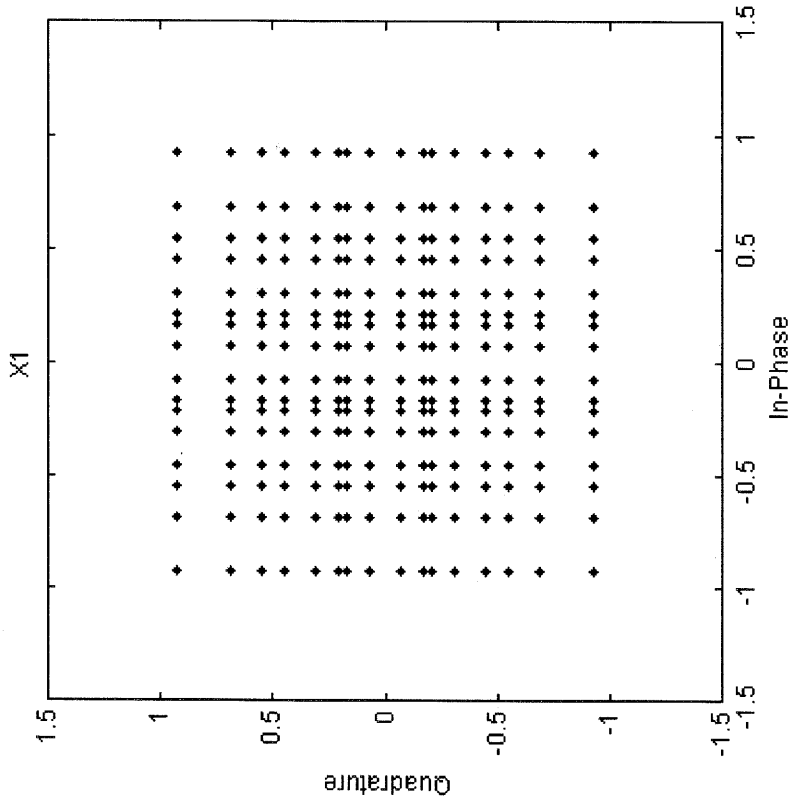


FIG. 118

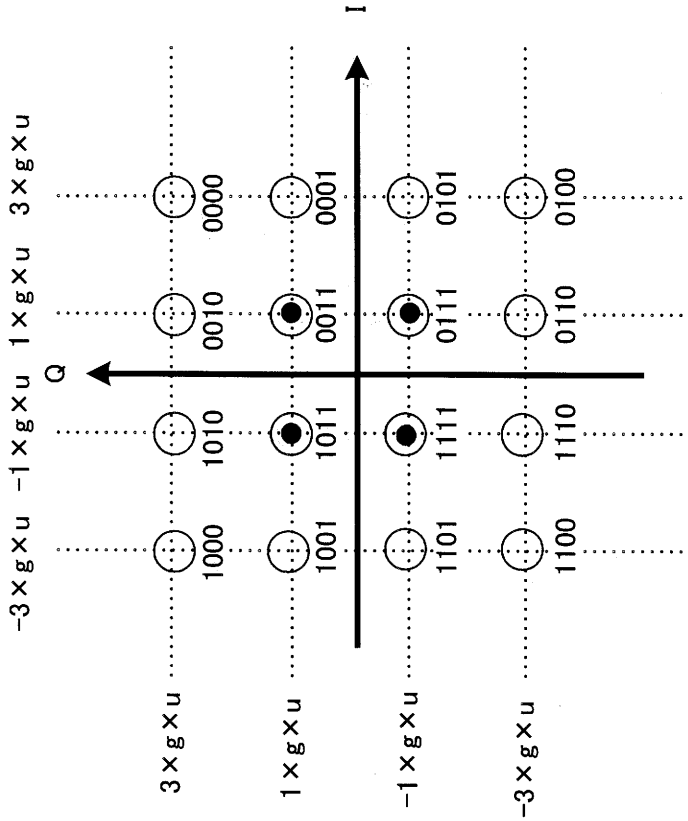

I
Q
-3×g×u
-1×g×u
1×g×u
3×g×u
0000
0001
0101
0100
0010
0011
0111
0110
1010
1011
1111
1110
1000
1001
1101
1100

FIG. 119

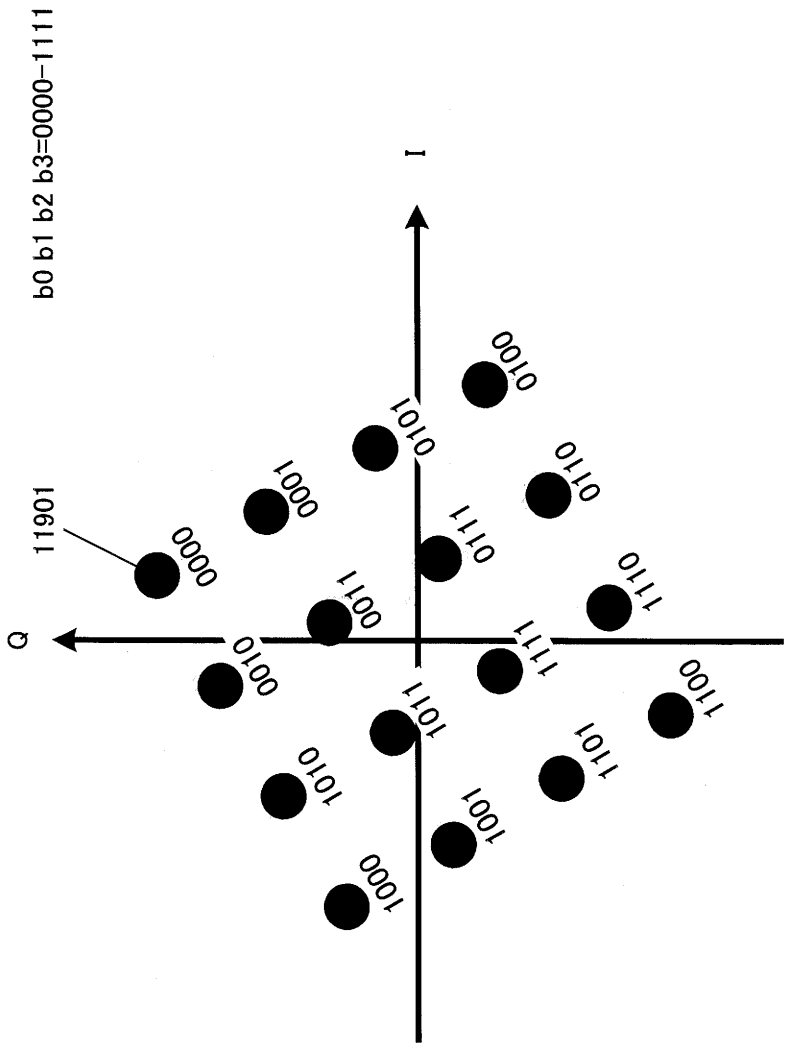

b0 b1 b2 b3=0000-1111
11901
I
Q
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

FIG. 120

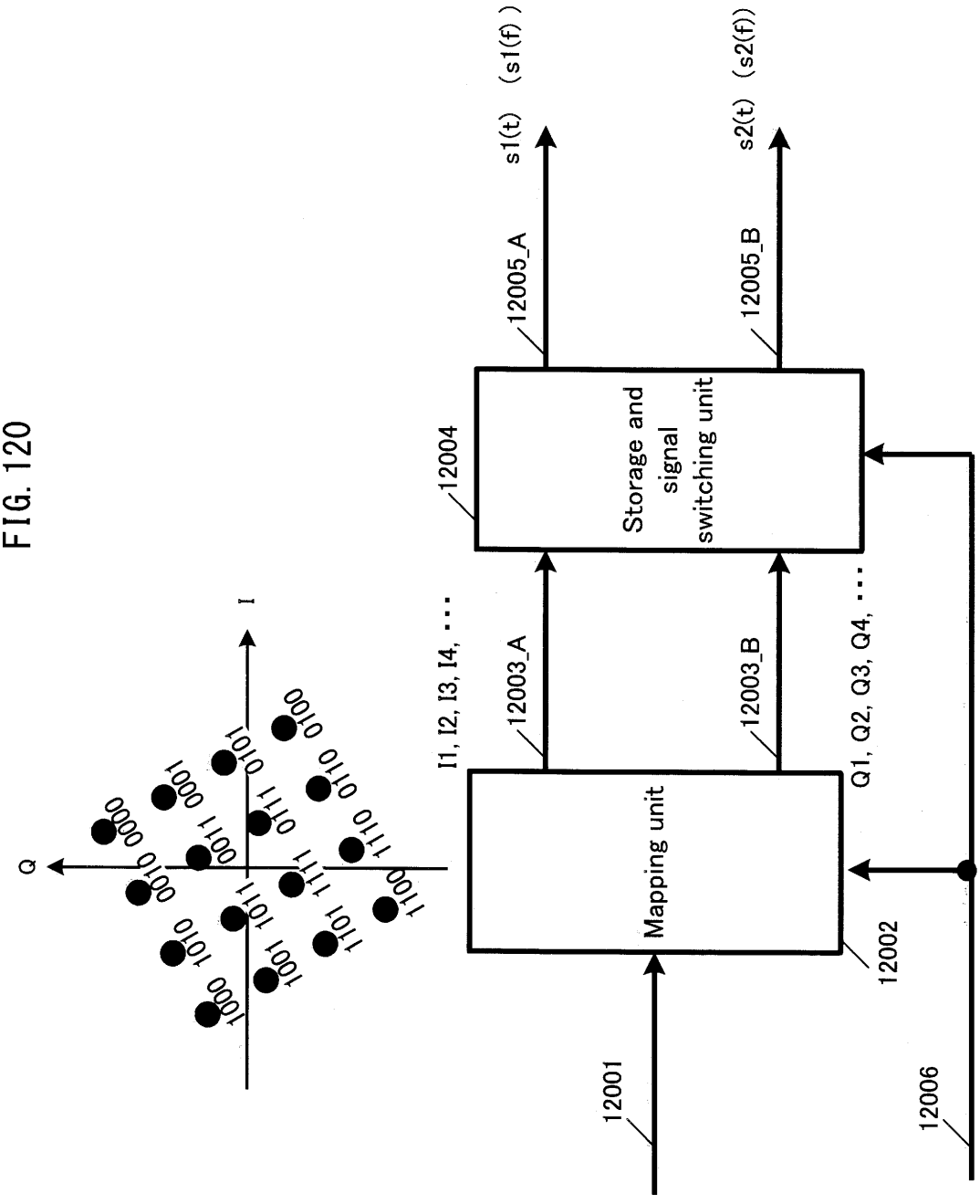

12001
12002
12003_A
12003_B
12004
12005_A
12005_B
12006
Mapping unit
Storage and signal switching unit
I1, I2, I3, I4, ...
Q1, Q2, Q3, Q4, ...
s1(t) (s1(f))
s2(t) (s2(f))
I
Q
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

FIG. 121

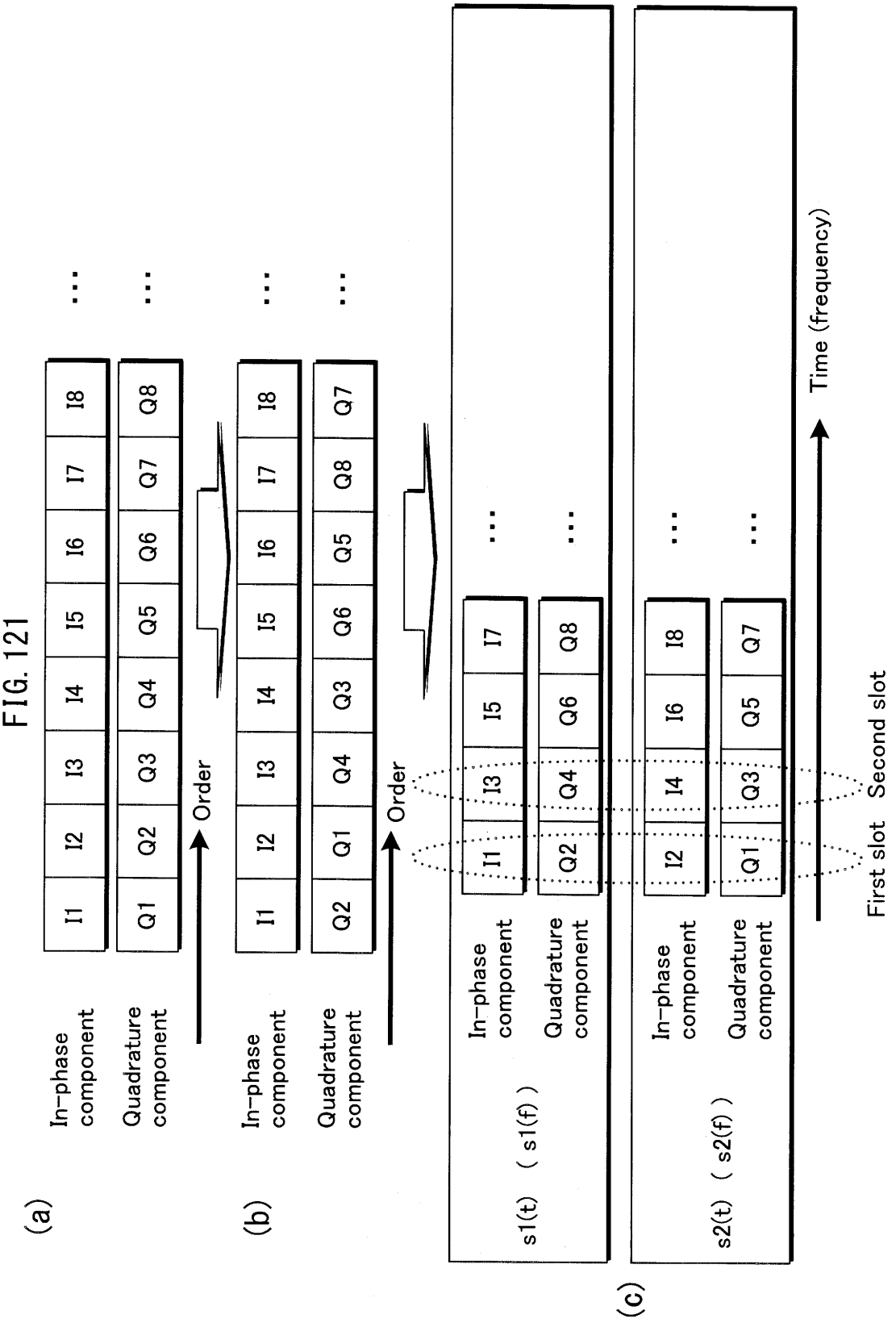

(a)
In-phase component
Quadrature component
I1 I2 I3 I4 I5 I6 I7 I8 ...
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 ...
Order
(b)
In-phase component
Quadrature component
I1 I2 I3 I4 I5 I6 I7 I8 ...
Q2 Q1 Q4 Q3 Q6 Q5 Q8 Q7 ...
Order
(c)
s1(t) (s1(f))
In-phase component
Quadrature component
I1 I3 I5 I7 ...
Q2 Q4 Q6 Q8 ...
s2(t) (s2(f))
In-phase component
Quadrature component
I2 I4 I6 I8 ...
Q1 Q3 Q5 Q7 ...
First slot
Second slot
Time (frequency)

FIG. 122

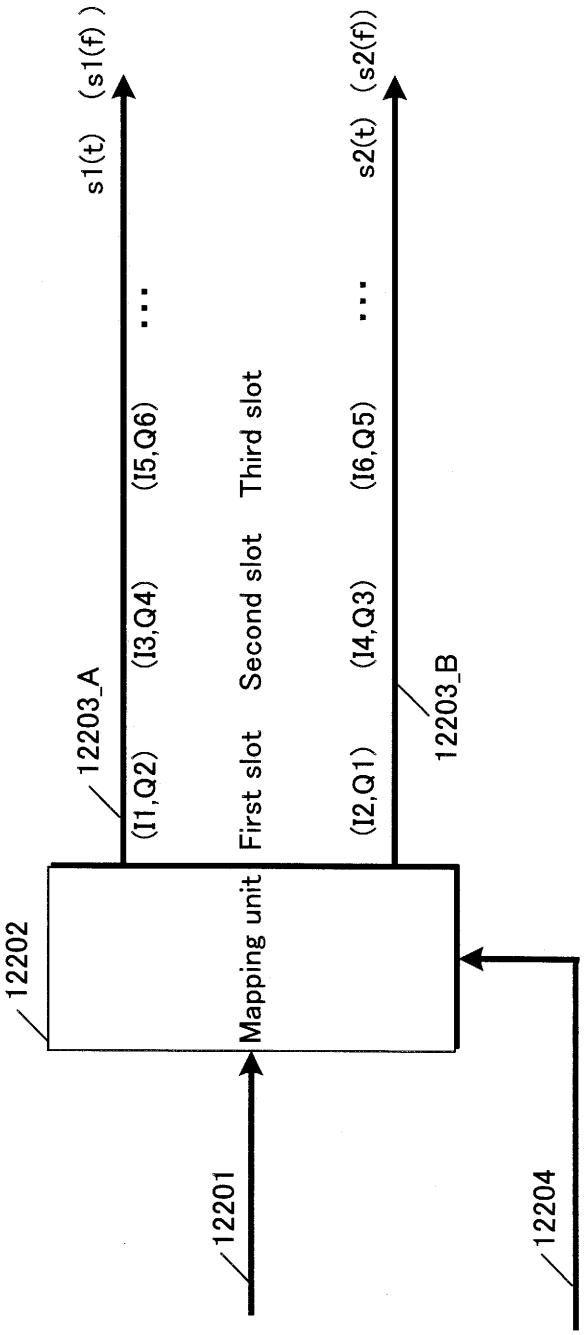

12201
12202
Mapping unit
12203_A
12203_B
12204
First slot
Second slot
Third slot
(I1,Q2)
(I3,Q4)
(I5,Q6)
(I2,Q1)
(I4,Q3)
(I6,Q5)
s1(t) (s1(f))
s2(t) (s2(f))

FIG. 123

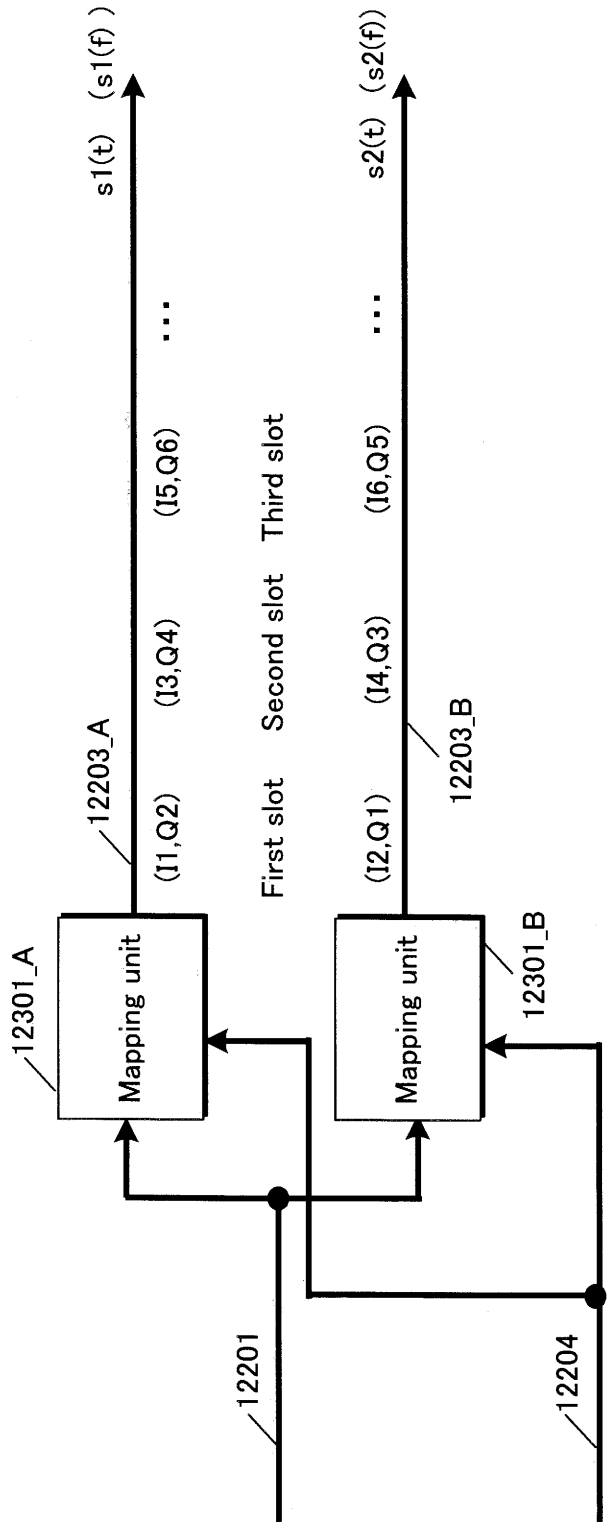

s1(t) (s1(f))
s2(t) (s2(f))
12203_A
12203_B
(I1,Q2)
(I3,Q4)
(I5,Q6)
...
(I2,Q1)
(I4,Q3)
(I6,Q5)
...
First slot
Second slot
Third slot
12301_A
12301_B
Mapping unit
Mapping unit
12201
12204

FIG. 124

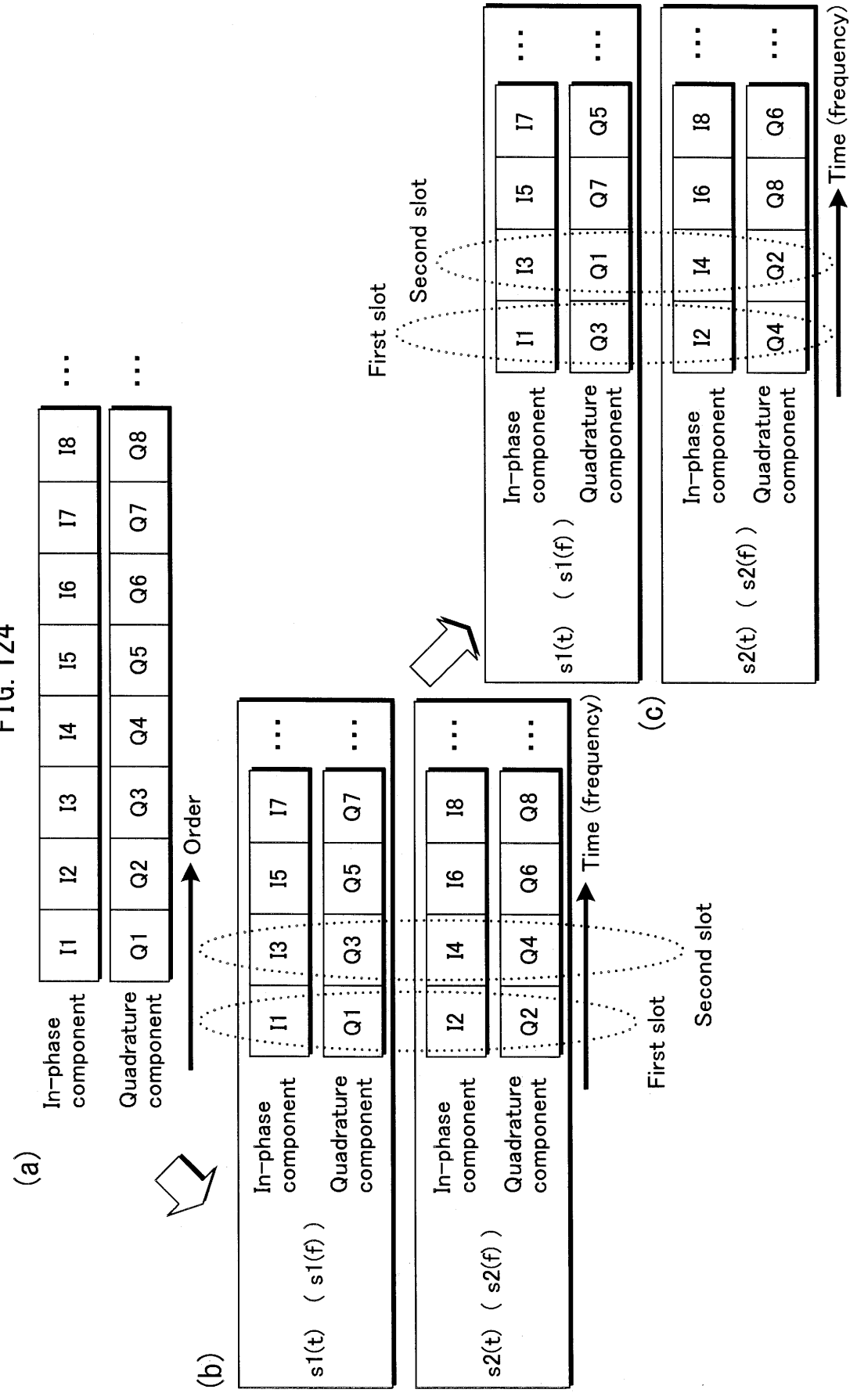

(a)
In-phase component
I1 I2 I3 I4 I5 I6 I7 I8 ...
Quadrature component
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 ...
Order
(b)
s1(t) (s1(f))
In-phase component
I1 I3 I5 I7 ...
Quadrature component
Q1 Q3 Q5 Q7 ...
s2(t) (s2(f))
In-phase component
I2 I4 I6 I8 ...
Quadrature component
Q2 Q4 Q6 Q8 ...
Time (frequency)
First slot
Second slot
(c)
s1(t) (s1(f))
In-phase component
I1 I3 I5 I7 ...
Quadrature component
Q3 Q1 Q7 Q5 ...
s2(t) (s2(f))
In-phase component
I2 I4 I6 I8 ...
Quadrature component
Q4 Q2 Q8 Q6 ...
First slot
Second slot
Time (frequency)

FIG. 125

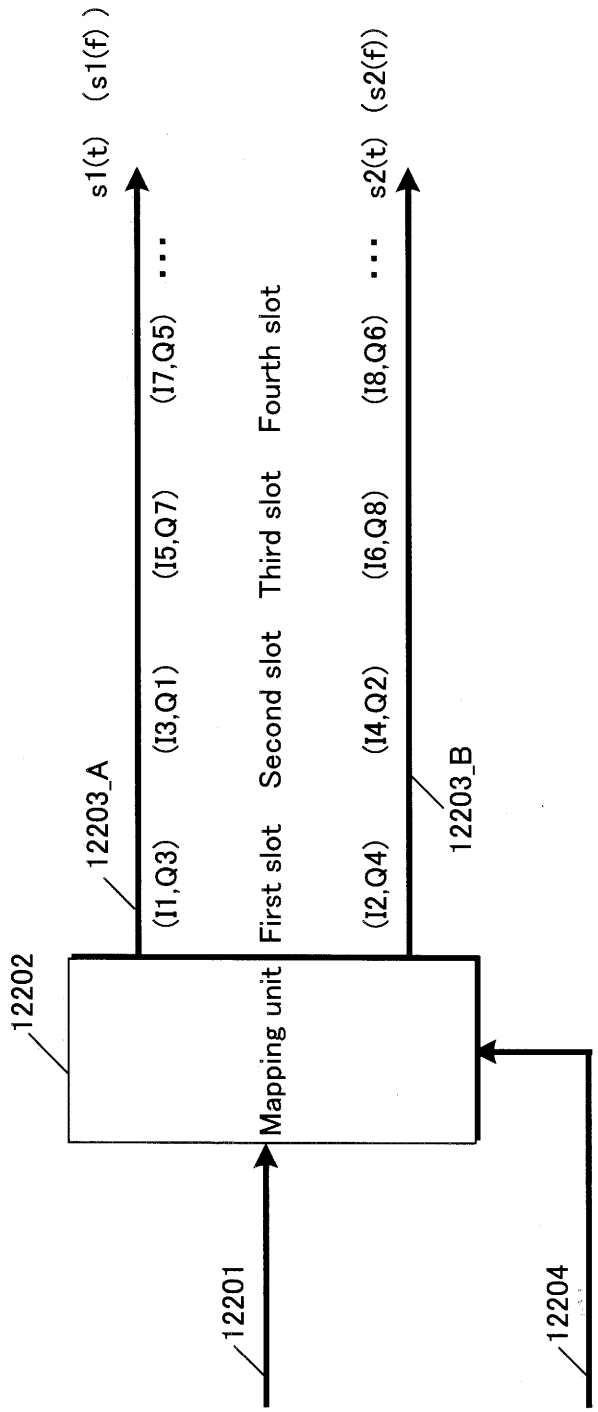
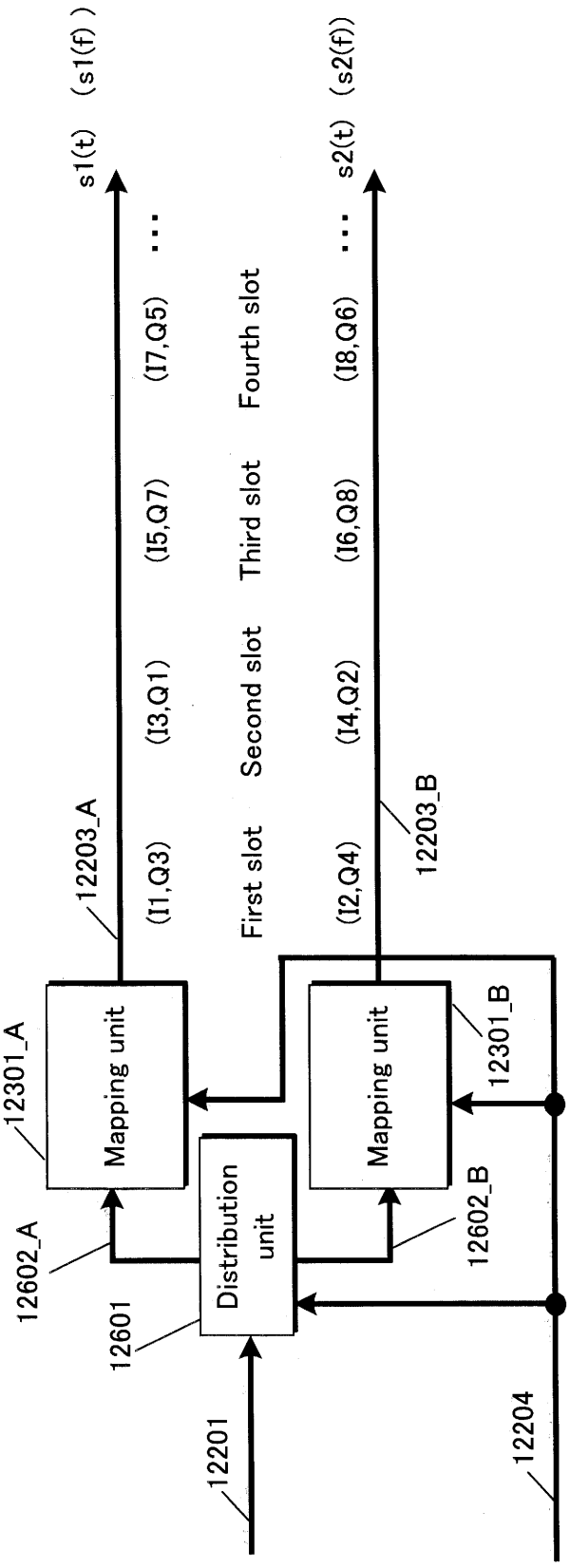

12201
12202
Mapping unit
12203_A
12203_B
12204
First slot
Second slot
Third slot
Fourth slot
(I1,Q3)
(I3,Q1)
(I5,Q7)
(I7,Q5)
(I2,Q4)
(I4,Q2)
(I6,Q8)
(I8,Q6)
s1(t) (s1(f))
s2(t) (s2(f))

FIG. 126


12201
12601
Distribution unit
12602_A
12602_B
12301_A
Mapping unit
12301_B
Mapping unit
12203_A
12203_B
12204
s1(t) (s1(f))
s2(t) (s2(f))
First slot
Second slot
Third slot
Fourth slot
(I1,Q3)
(I3,Q1)
(I5,Q7)
(I7,Q5)
(I2,Q4)
(I4,Q2)
(I6,Q8)
(I8,Q6)