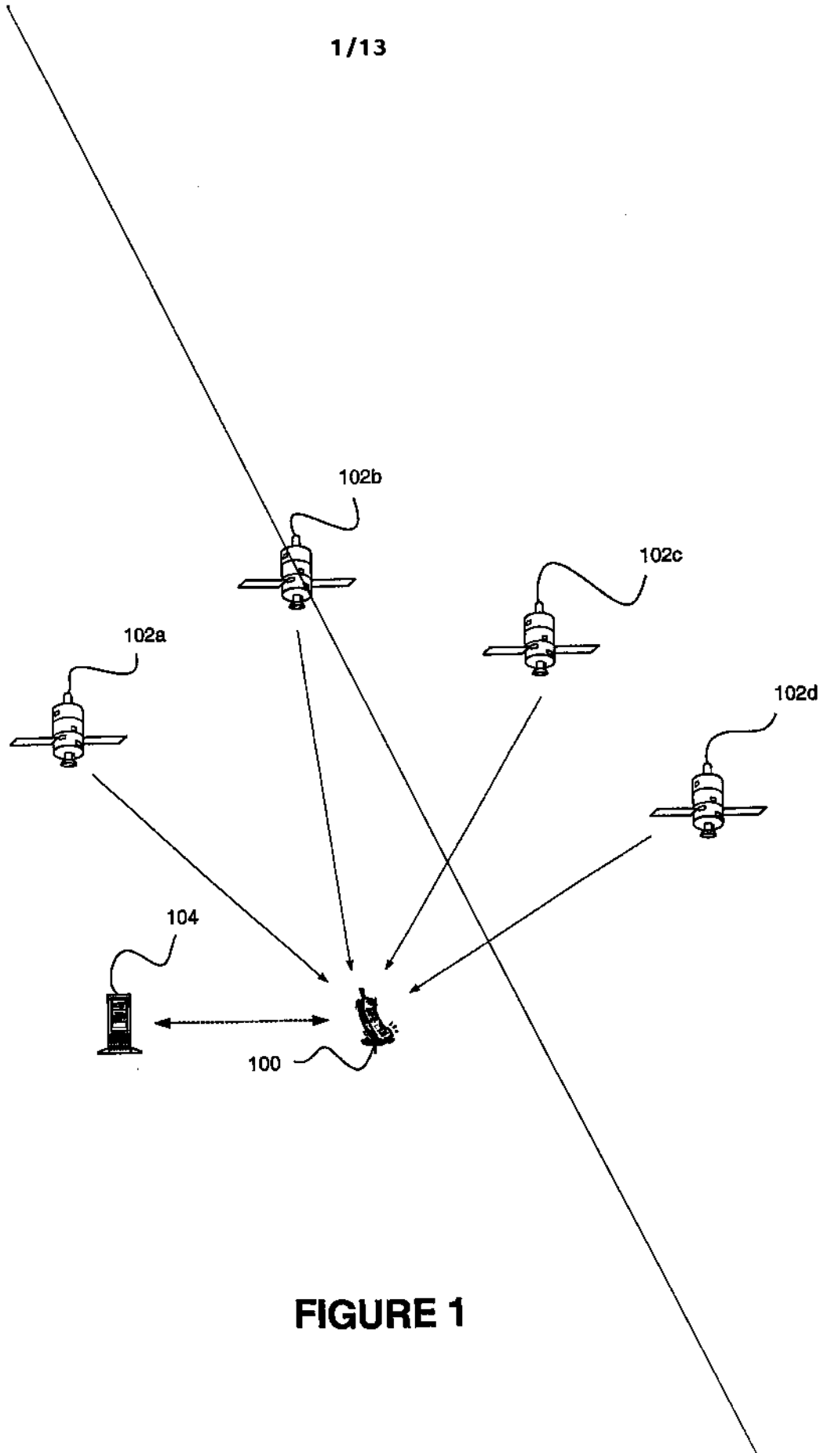


FIGURE 1

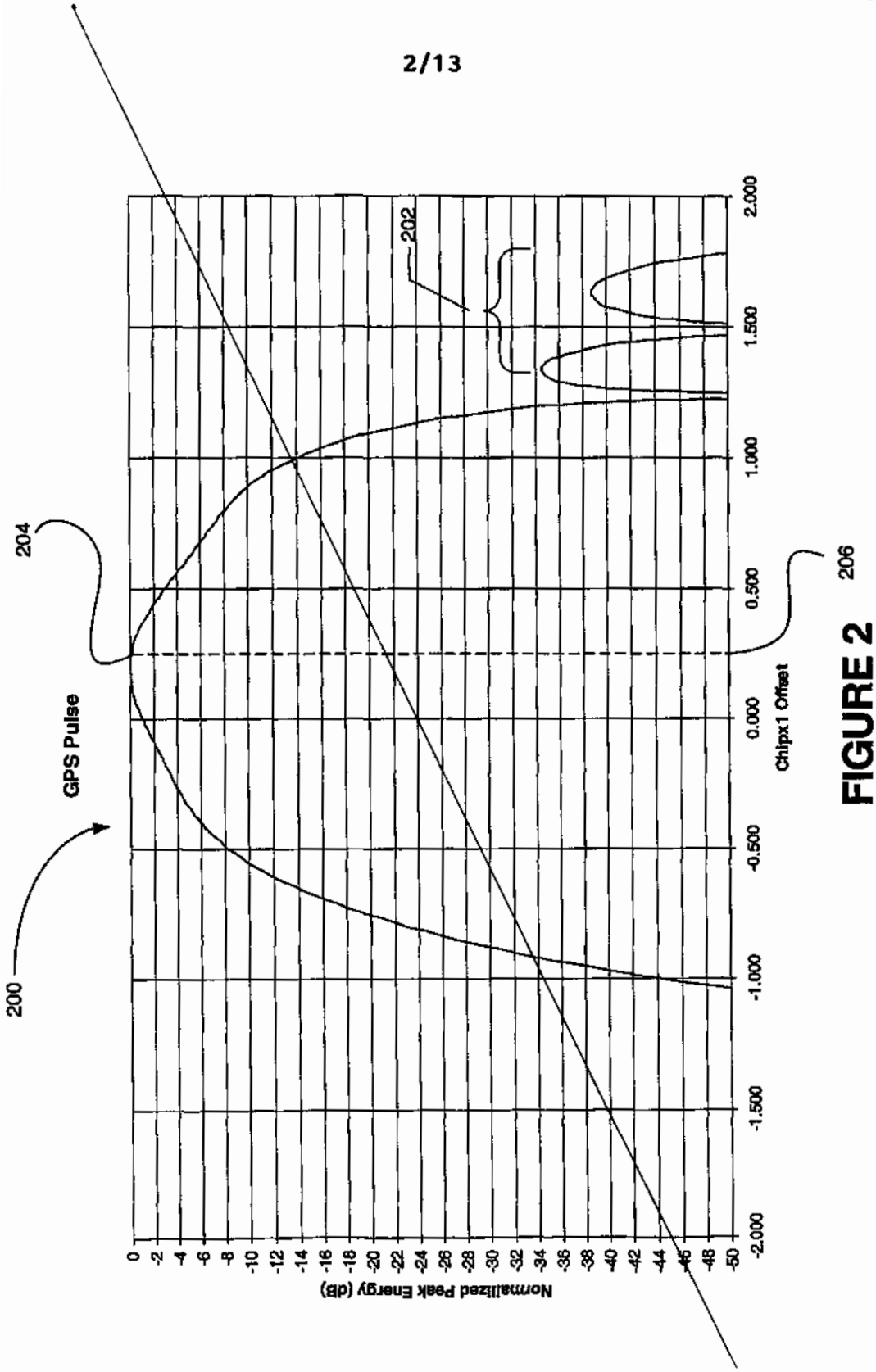

200
GPS Pulse
204
202
206
Normalized Peak Energy (dB)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
-42
-44
-46
-48
-50
2.000
1.500
1.000
0.500
0.000
-0.500
-1.000
-1.500
-2.000
Chipx1 Offset

FIGURE 2

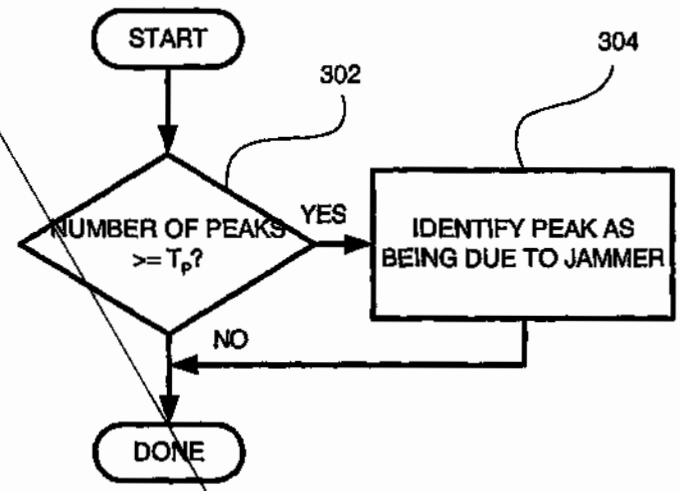


FIGURE 3

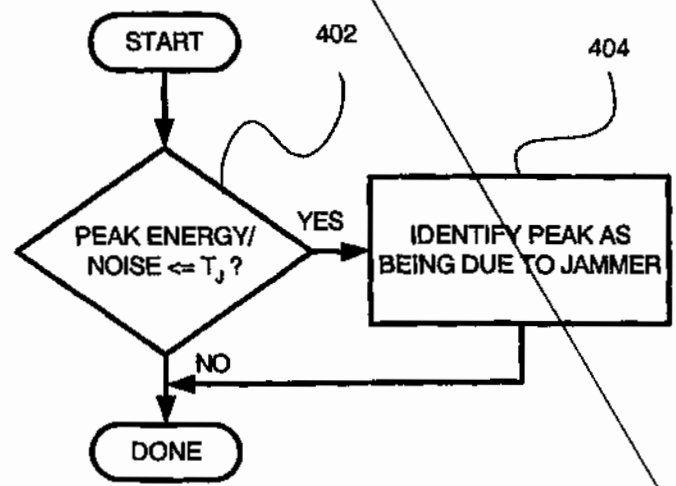


FIGURE 4

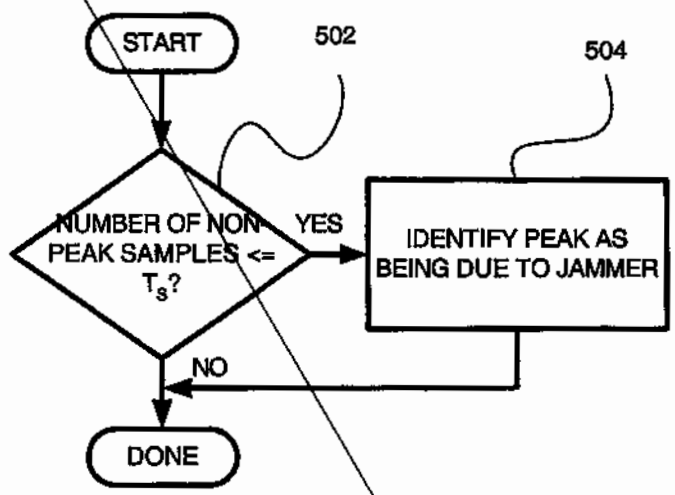

START
502
504
NUMBER OF NON PEAK SAMPLES <= T_S?
YES
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
DONE

FIGURE 5A

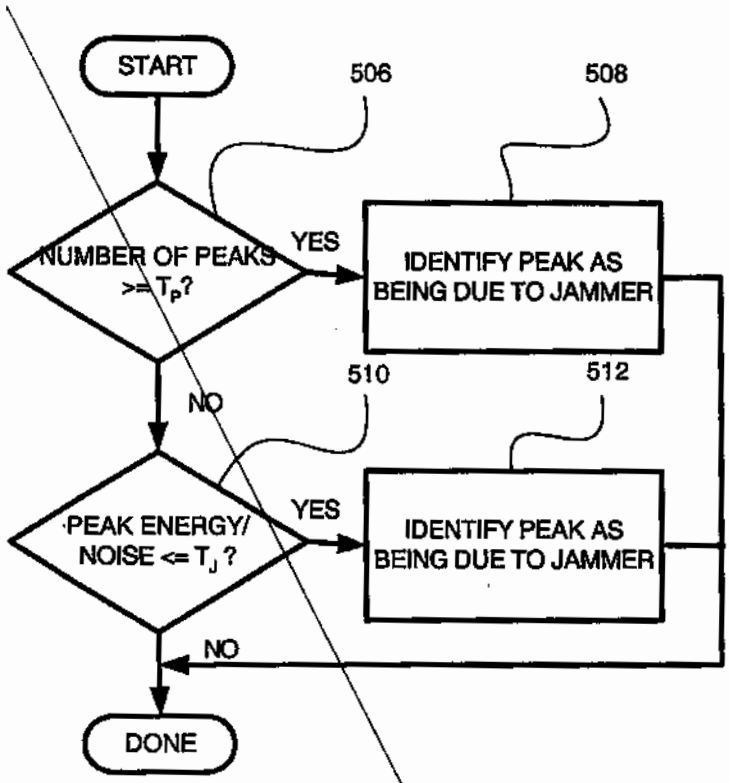


FIGURE 5B

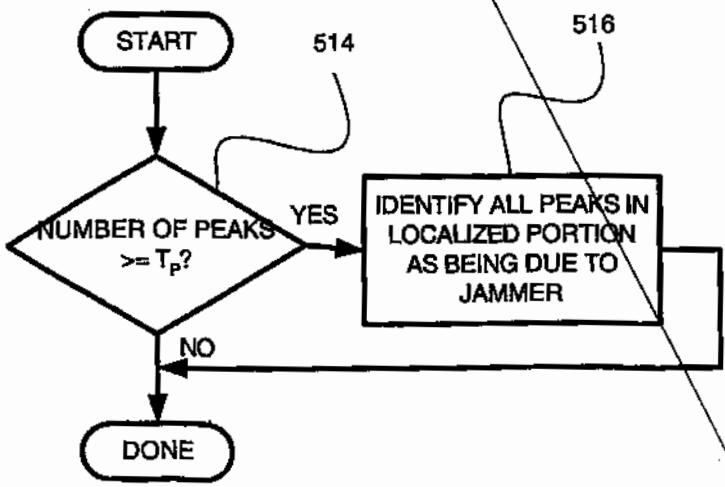


FIGURE 5C

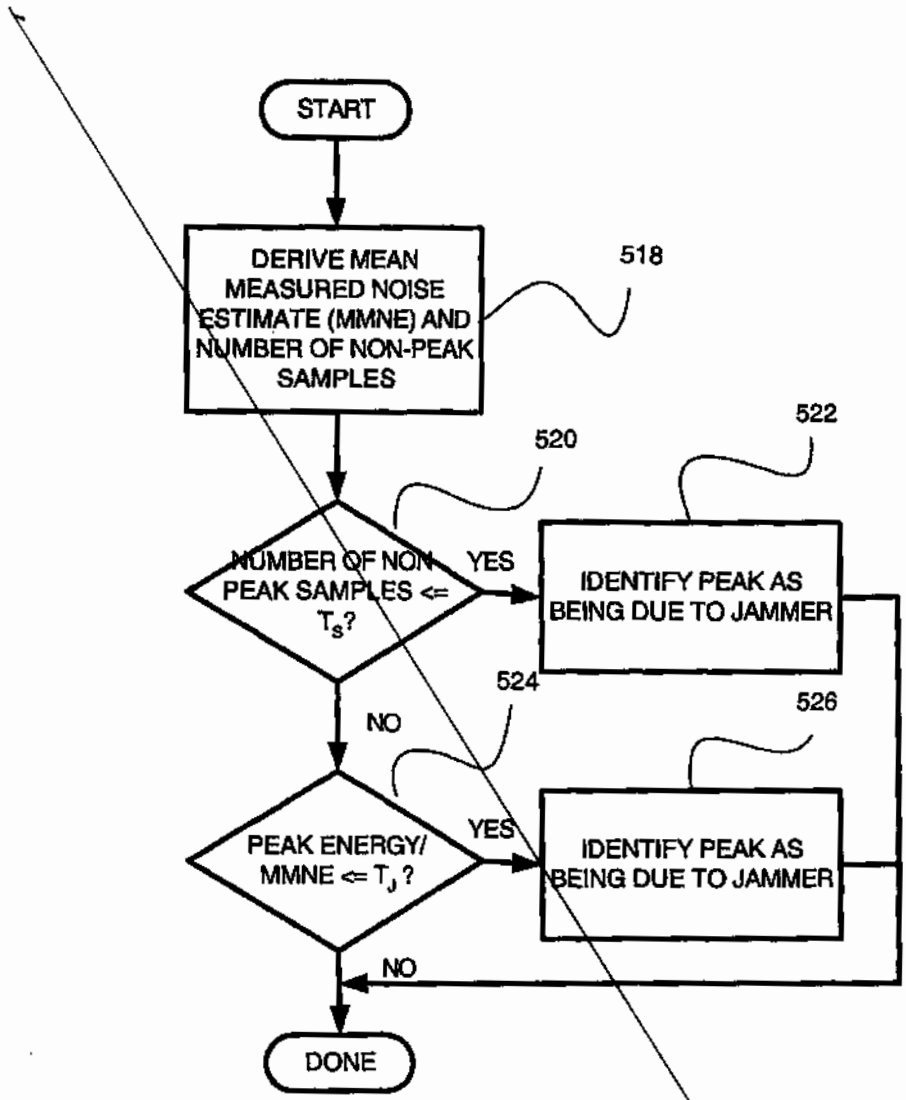

START
DERIVE MEAN MEASURED NOISE ESTIMATE (MMNE) AND NUMBER OF NON-PEAK SAMPLES
518
520
522
NUMBER OF NON-PEAK SAMPLES <= T_s?
YES
IDENTIFY PEAK AS BEING DUE TO JAMMER
524
526
NO
PEAK ENERGY/ MMNE <= T_J ?
YES
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
DONE

FIGURE 5D

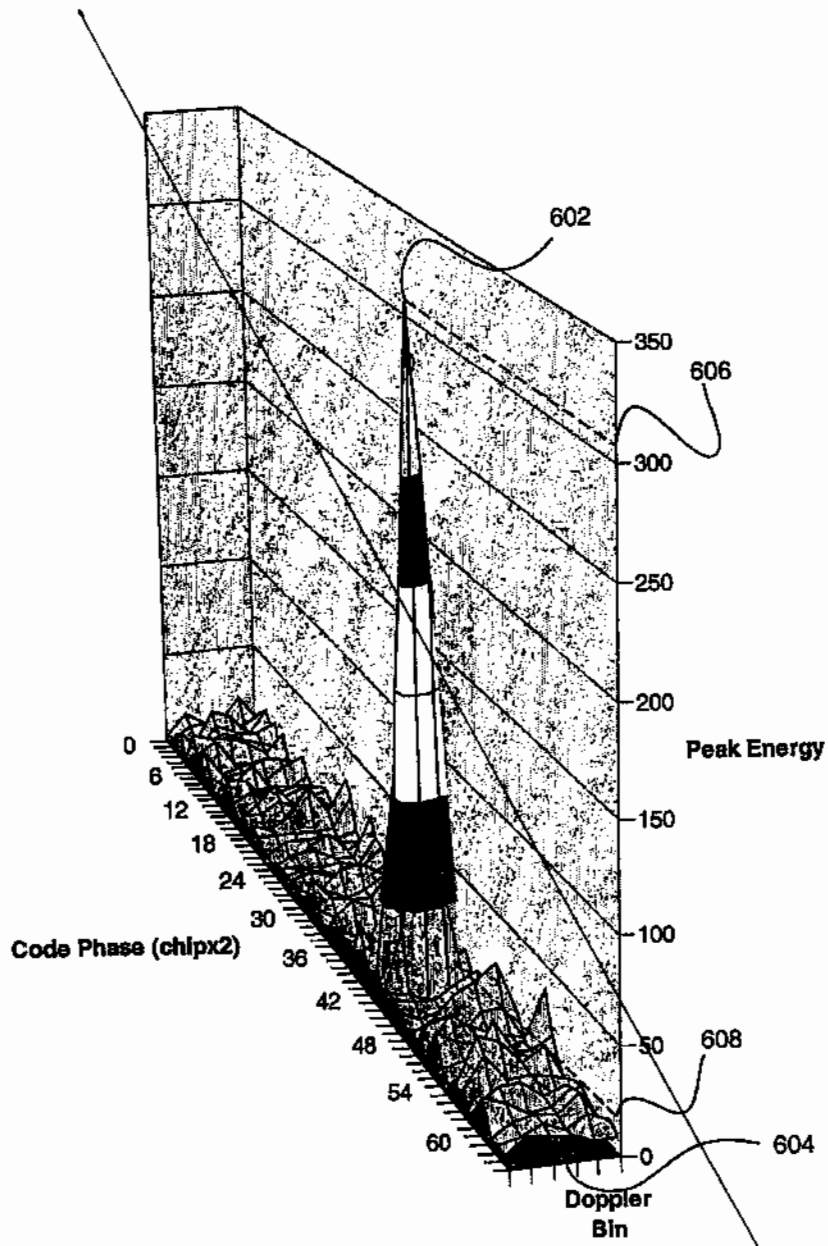

602
606
608
604
350
300
250
200
150
100
50
0
Peak Energy
0
6
12
18
24
30
36
42
48
54
60
Code Phase (chipx2)
Doppler
Bin

FIGURE 6

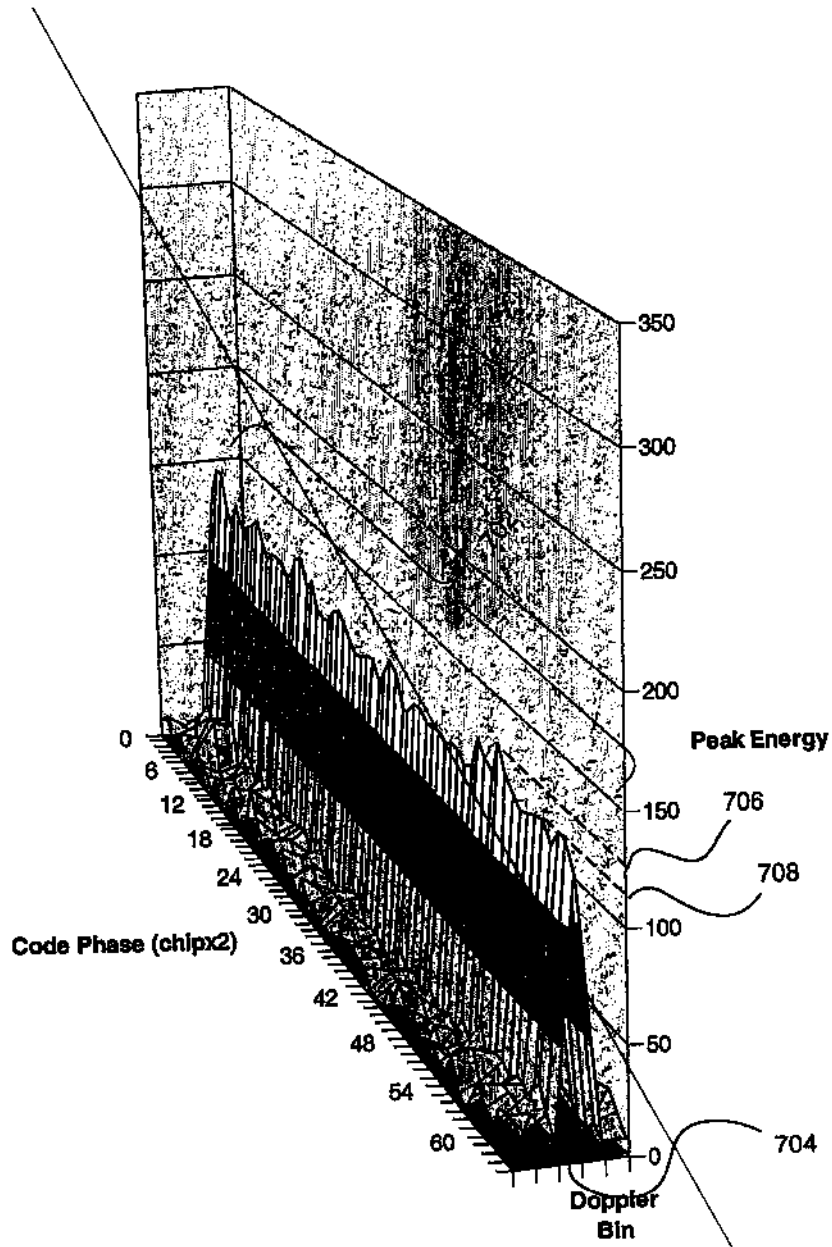

350
300
250
200
Peak Energy
150
706
708
100
50
0
704
0
6
12
18
24
30
36
42
48
54
60
Code Phase (chipx2)
Doppler
Bin

FIGURE 7

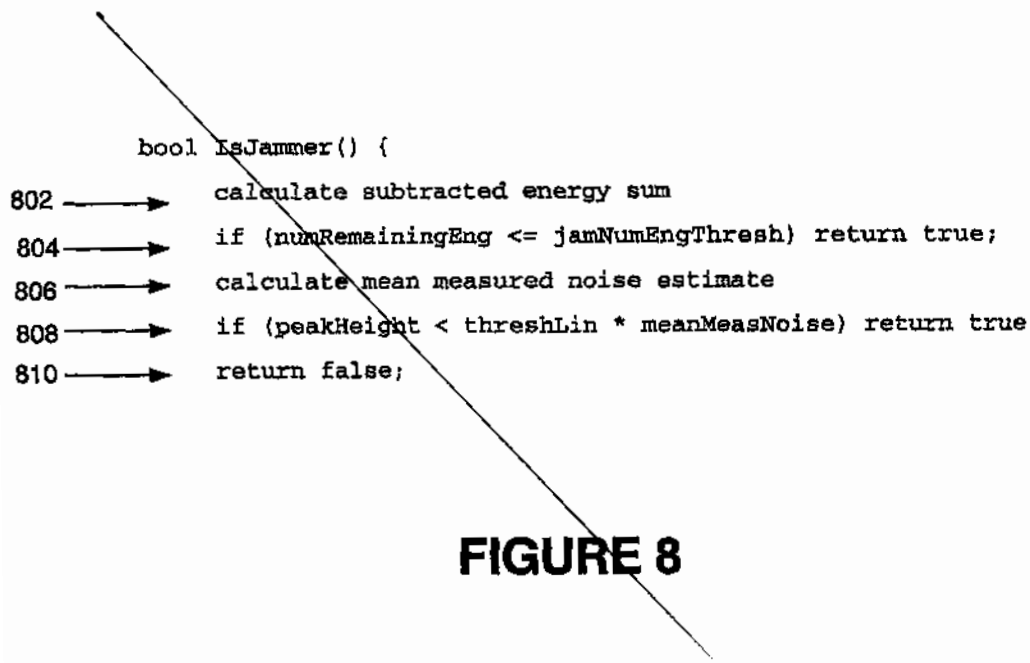
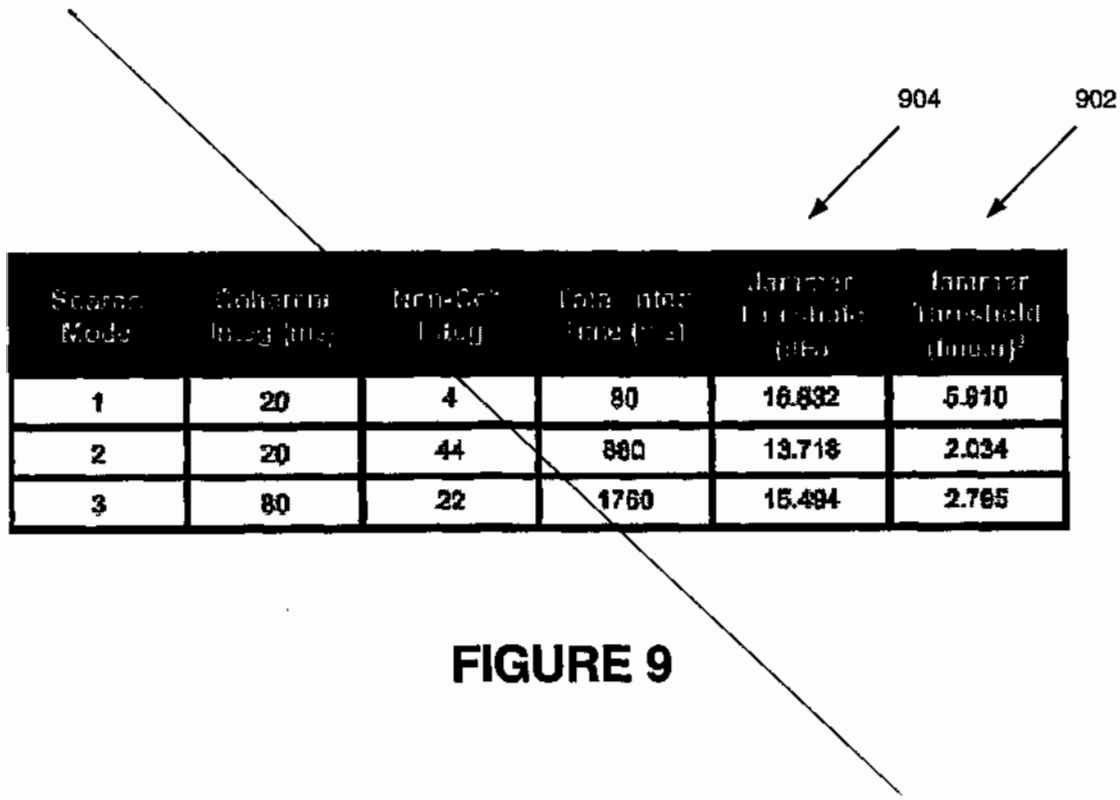

bool IsJammer() {
802
calculate subtracted energy sum
804
if (numRemainingEng <= jamNumEngThresh) return true;
806
calculate mean measured noise estimate
808
if (peakHeight < threshLin * meanMeasNoise) return true;
810
return false;

FIGURE 8



Search Mode	Coherent Integration	Non-Coherent Integration	Data Interleaver Size (Bits)	Jammer Power Estimate (dBm)	Jammer Threshold (dBm)[2]
1	20	4	80	16.632	5.910
2	20	44	880	13.718	2.034
3	80	22	1760	15.494	2.765

FIGURE 9

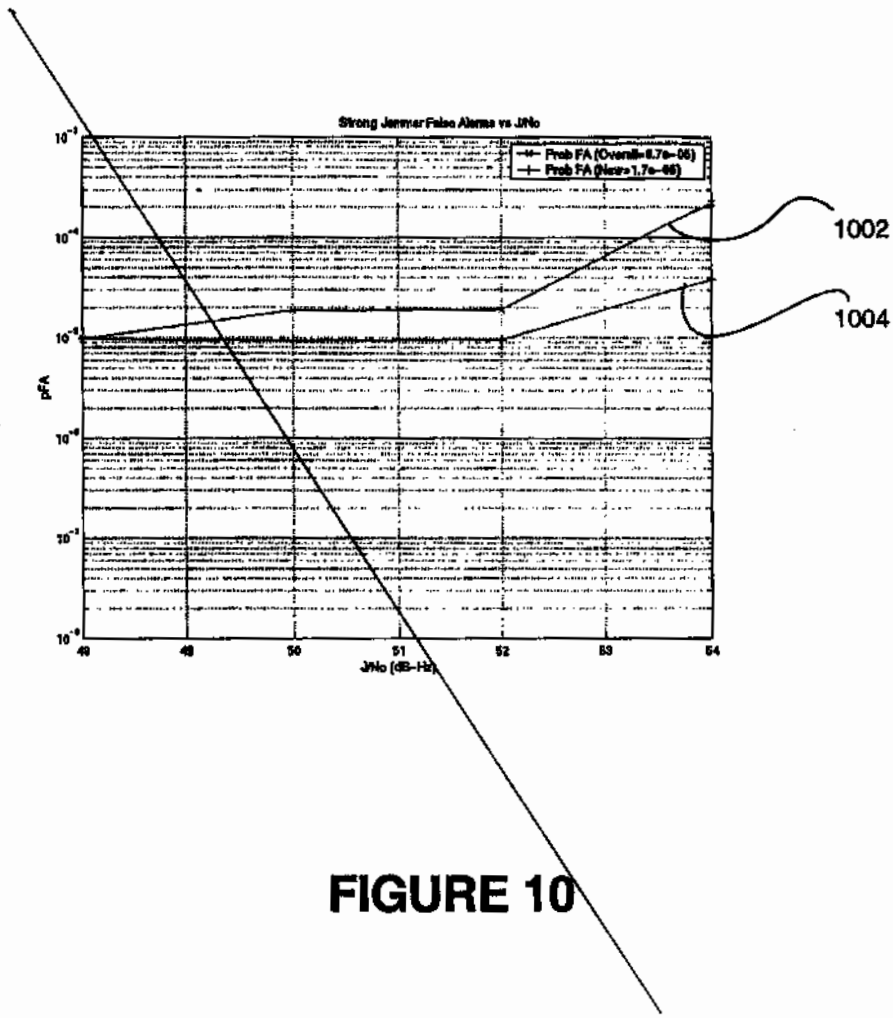

Strong Jammer False Alarms vs J/No
Prob FA (Overall=6.7e-06)
Prob FA (Near>1.7e-06)
pFA
J/No (dB-Hz)
1002
1004

FIGURE 10

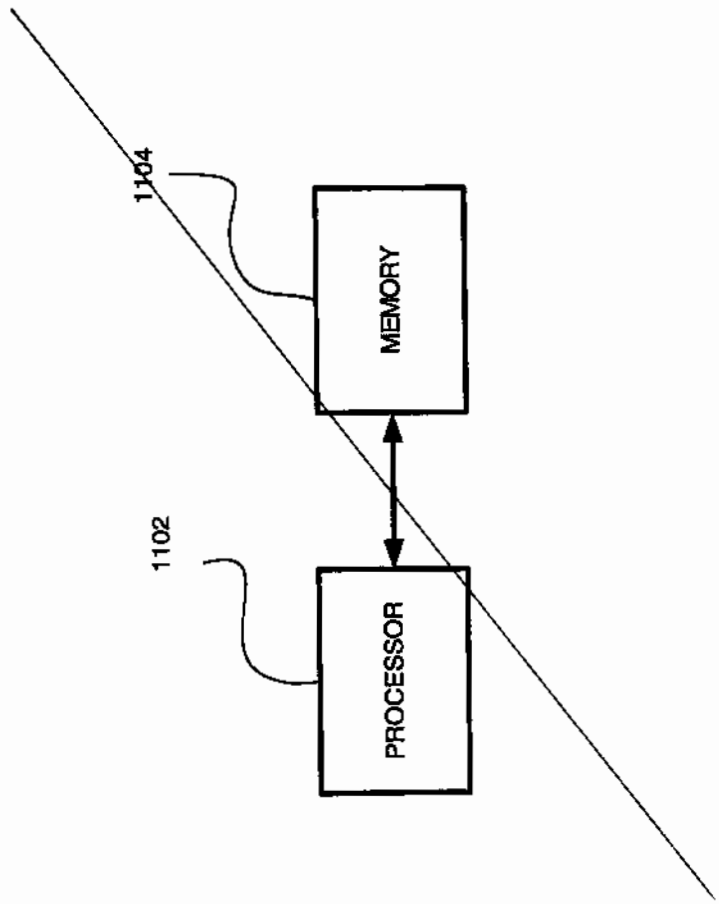


FIGURE 11

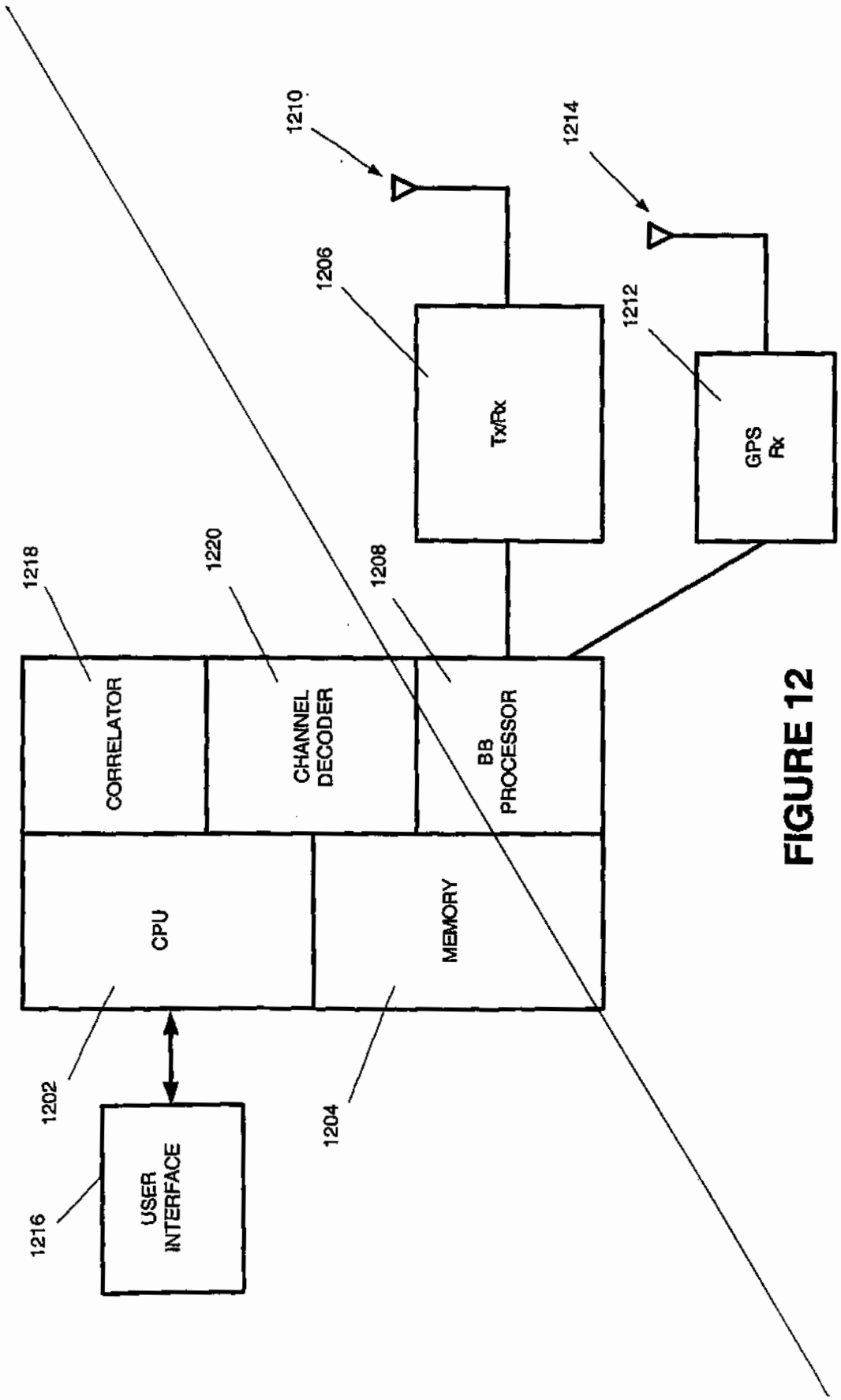

1210
1214
1206
1212
Tx/Rx
GPS Rx
1218
1220
1208
CORRELATOR
CHANNEL DECODER
BB PROCESSOR
CPU
MEMORY
1202
1204
1216
USER INTERFACE

FIGURE 12

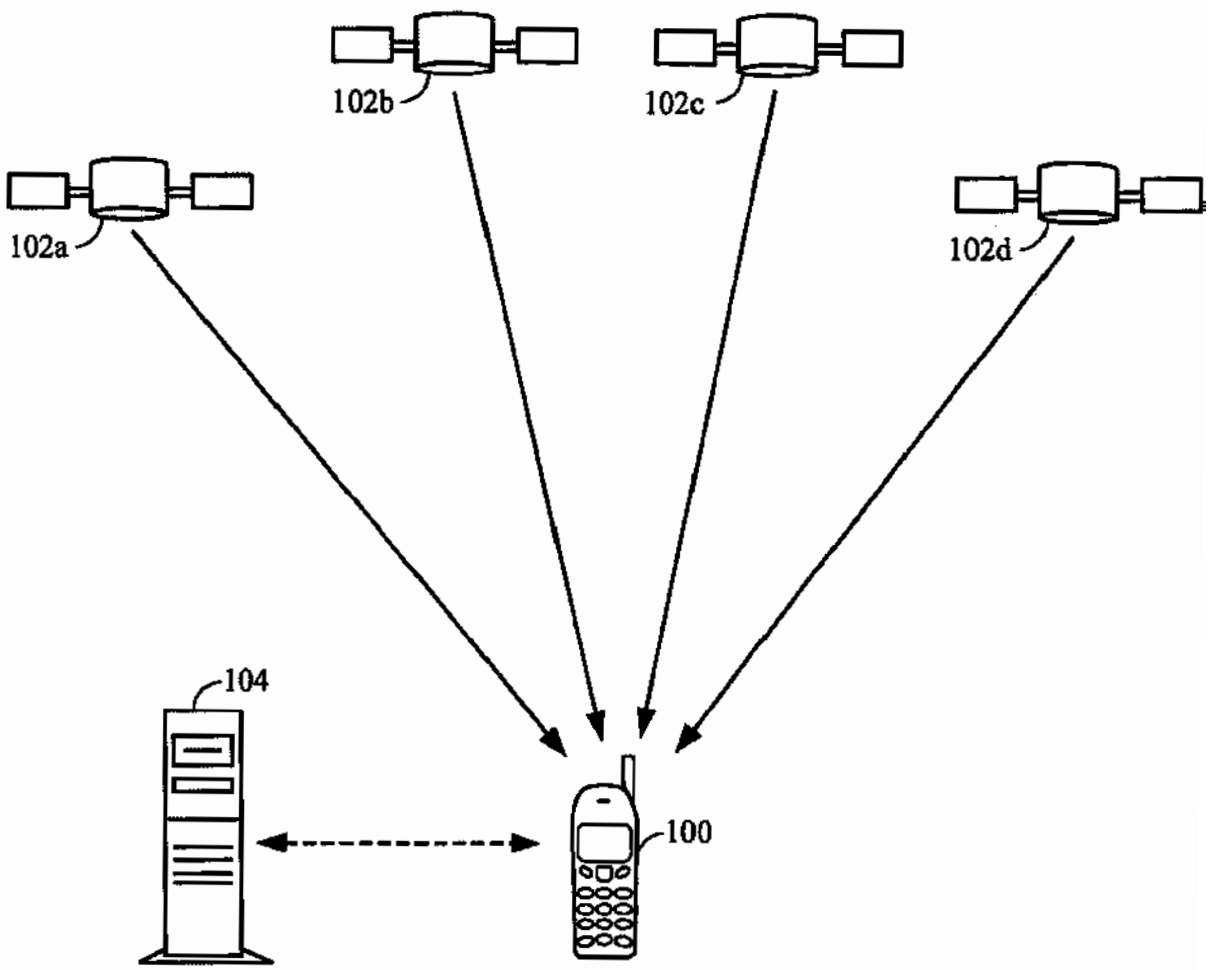


FIG. 1

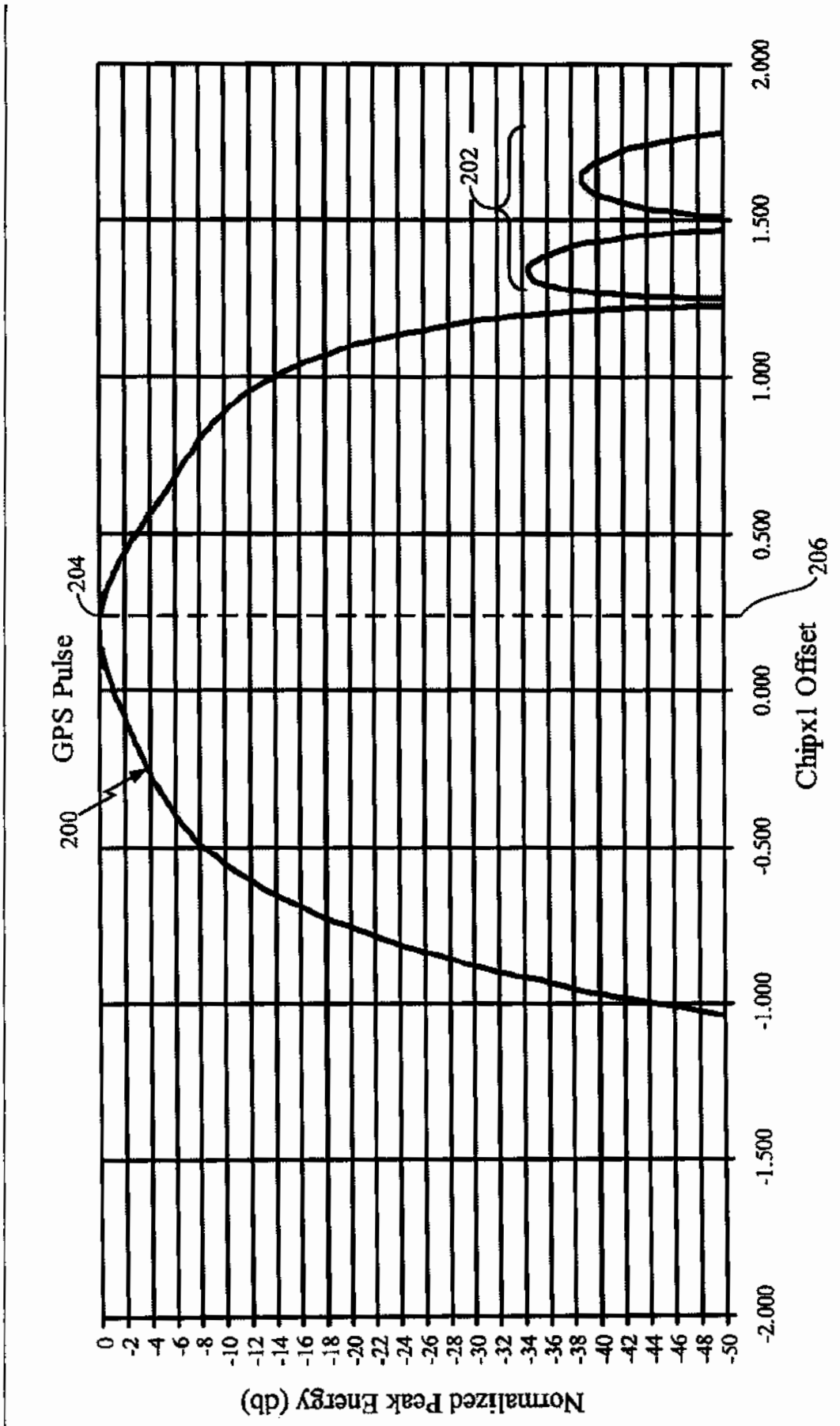

Normalized Peak Energy (db)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
-42
-44
-46
-48
-50
2.000
1.500
1.000
0.500
0.000
-0.500
-1.000
-1.500
-2.000
Chipx1 Offset
GPS Pulse
200
202
204
206

FIG. 2

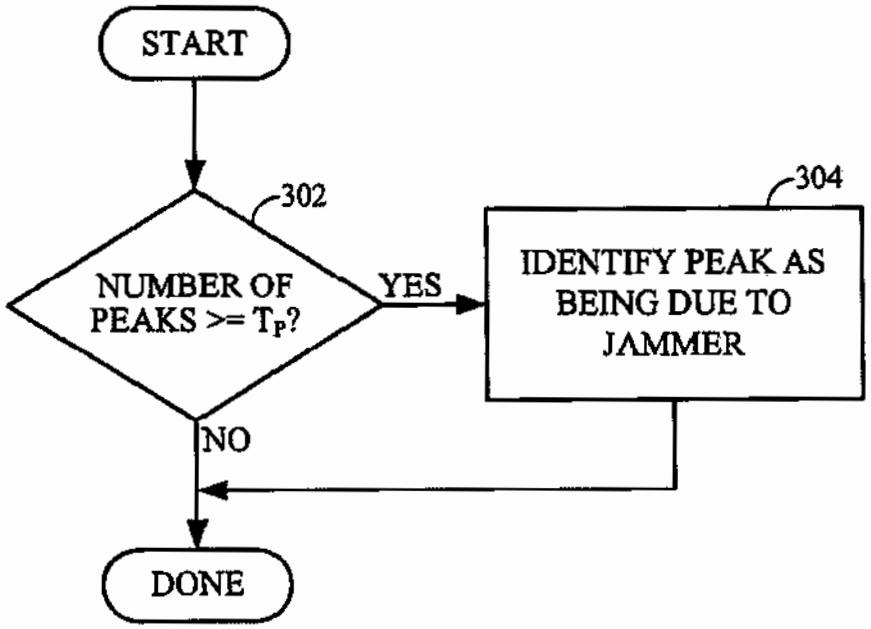

START
302
NUMBER OF PEAKS >= T_P?
YES
304
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
DONE

FIG. 3

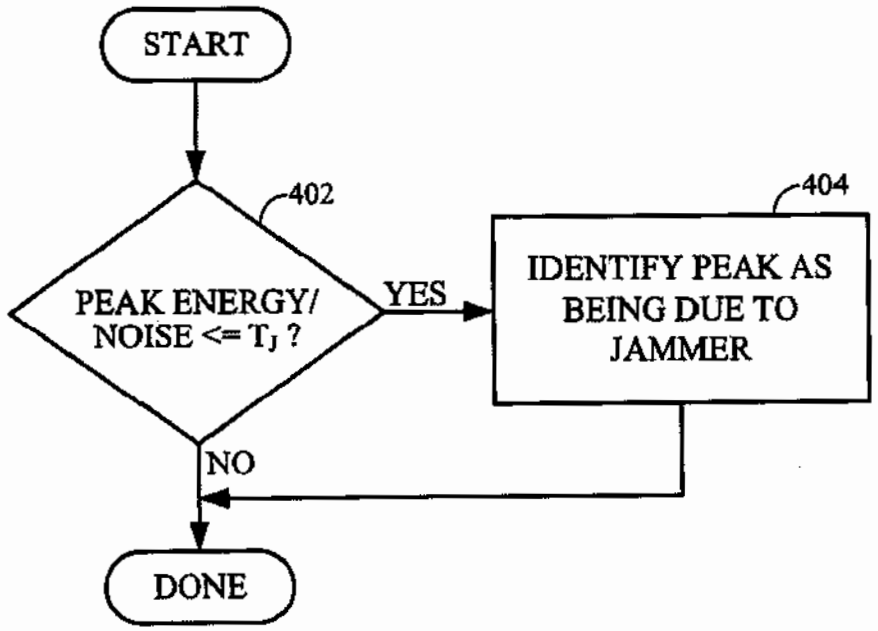

START
402
PEAK ENERGY/ NOISE <= T_J ?
YES
404
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
DONE

FIG. 4

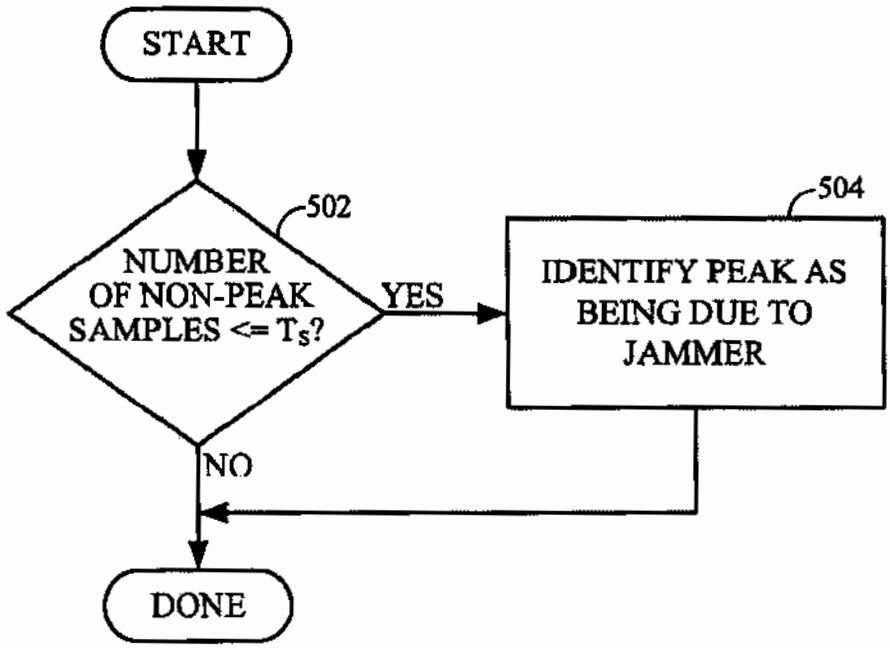

START
502
NUMBER OF NON-PEAK SAMPLES <= T_S?
YES
504
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
DONE

FIG. 5A

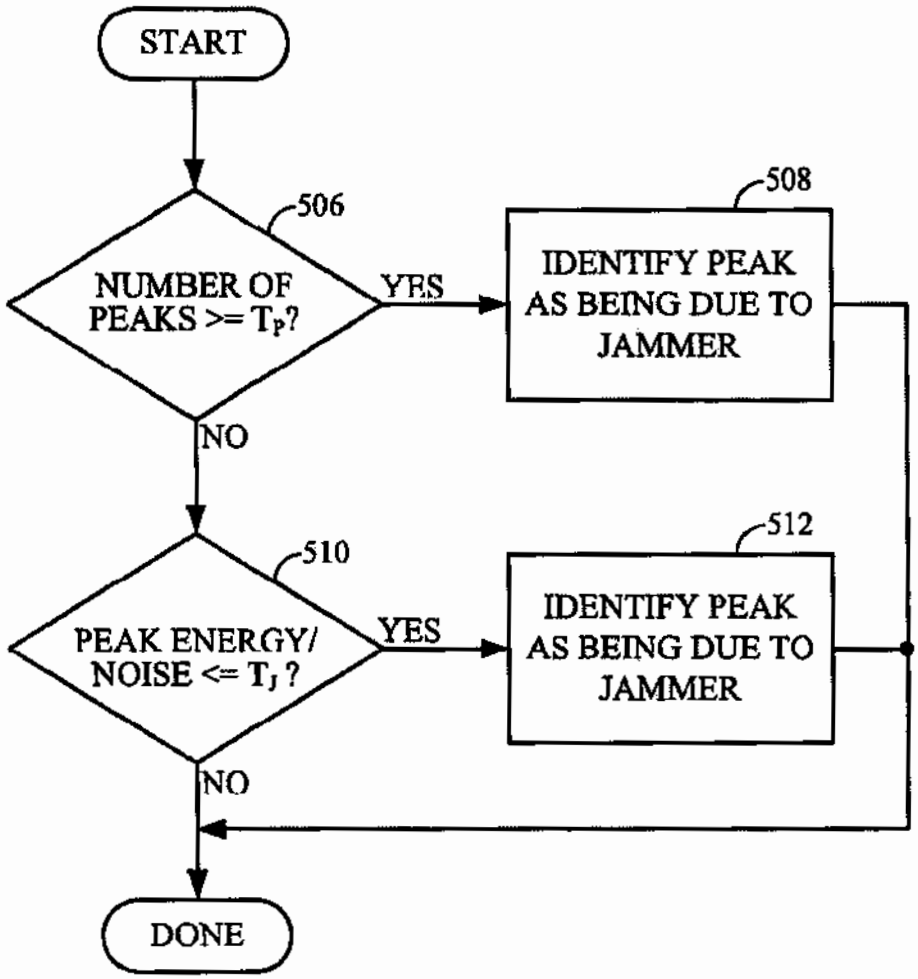

START
506
NUMBER OF PEAKS >= T_P?
YES
508
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
510
PEAK ENERGY/ NOISE <= T_J ?
YES
512
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
DONE

FIG. 5B

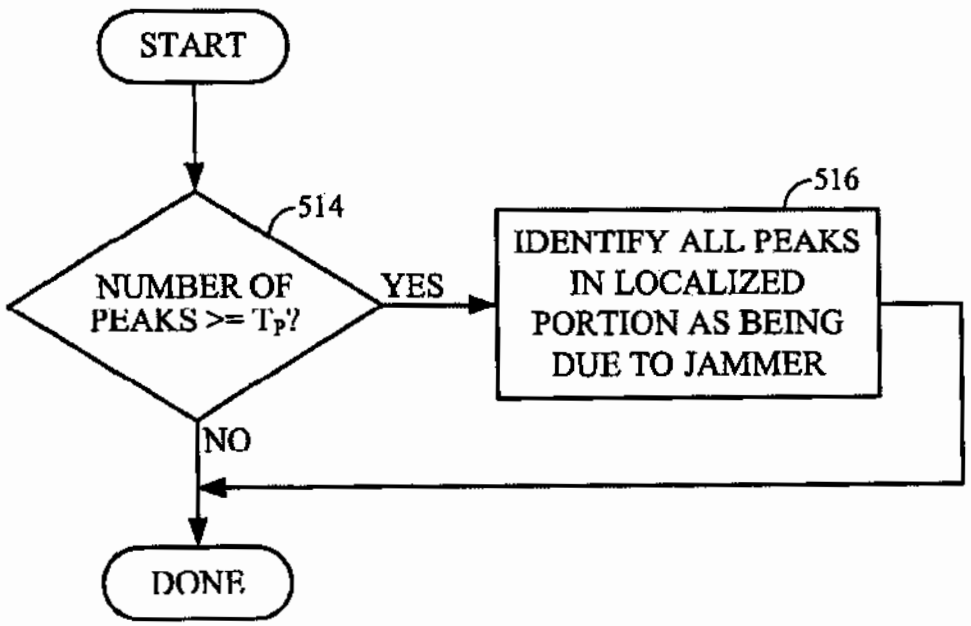

START
514
NUMBER OF PEAKS >= T_P?
YES
516
IDENTIFY ALL PEAKS IN LOCALIZED PORTION AS BEING DUE TO JAMMER
NO
DONE

FIG. 5C

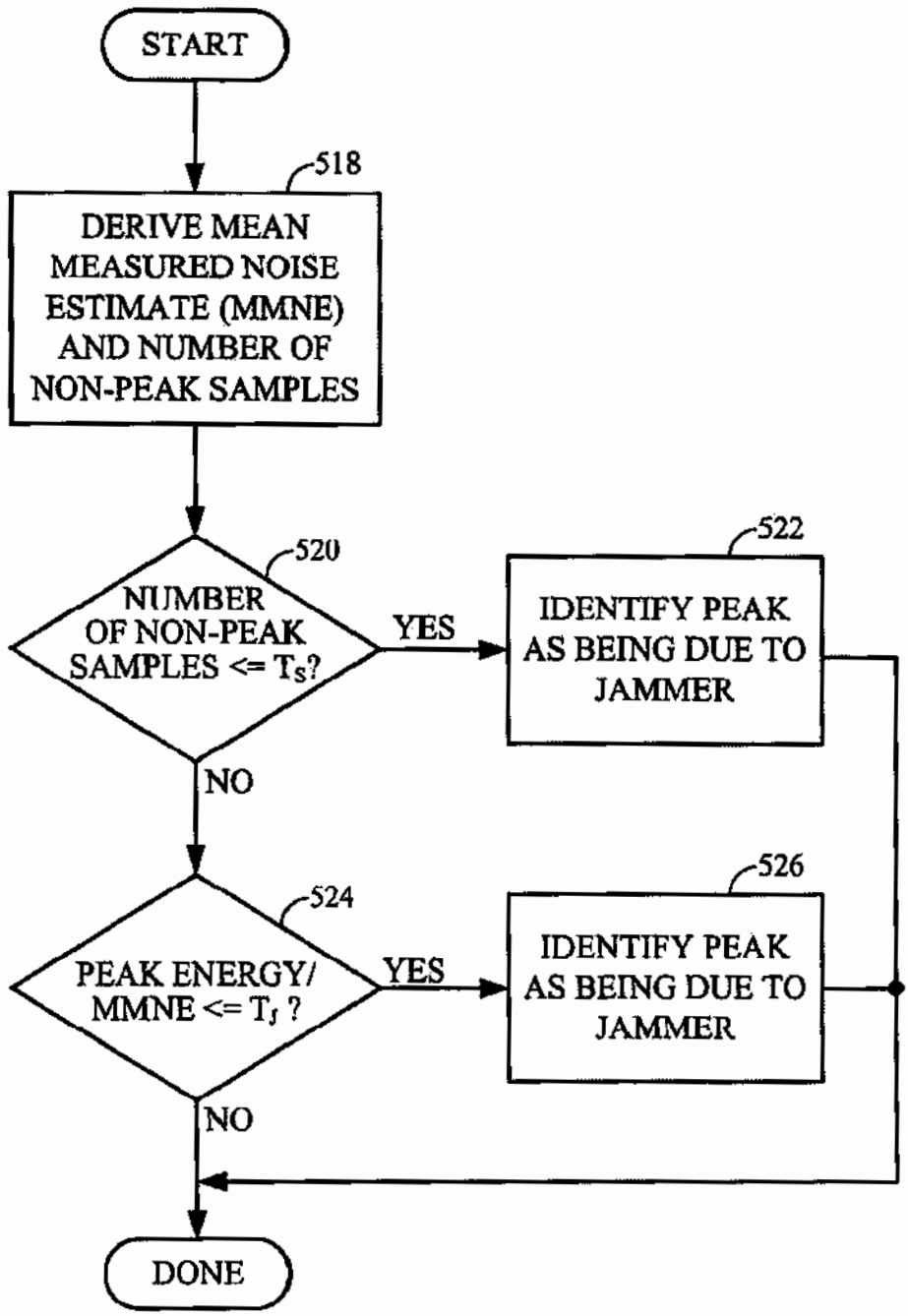

START
518
DERIVE MEAN MEASURED NOISE ESTIMATE (MMNE) AND NUMBER OF NON-PEAK SAMPLES
520
NUMBER OF NON-PEAK SAMPLES <= T_S?
YES
522
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
524
PEAK ENERGY/ MMNE <= T_J ?
YES
526
IDENTIFY PEAK AS BEING DUE TO JAMMER
NO
DONE

FIG. 5D

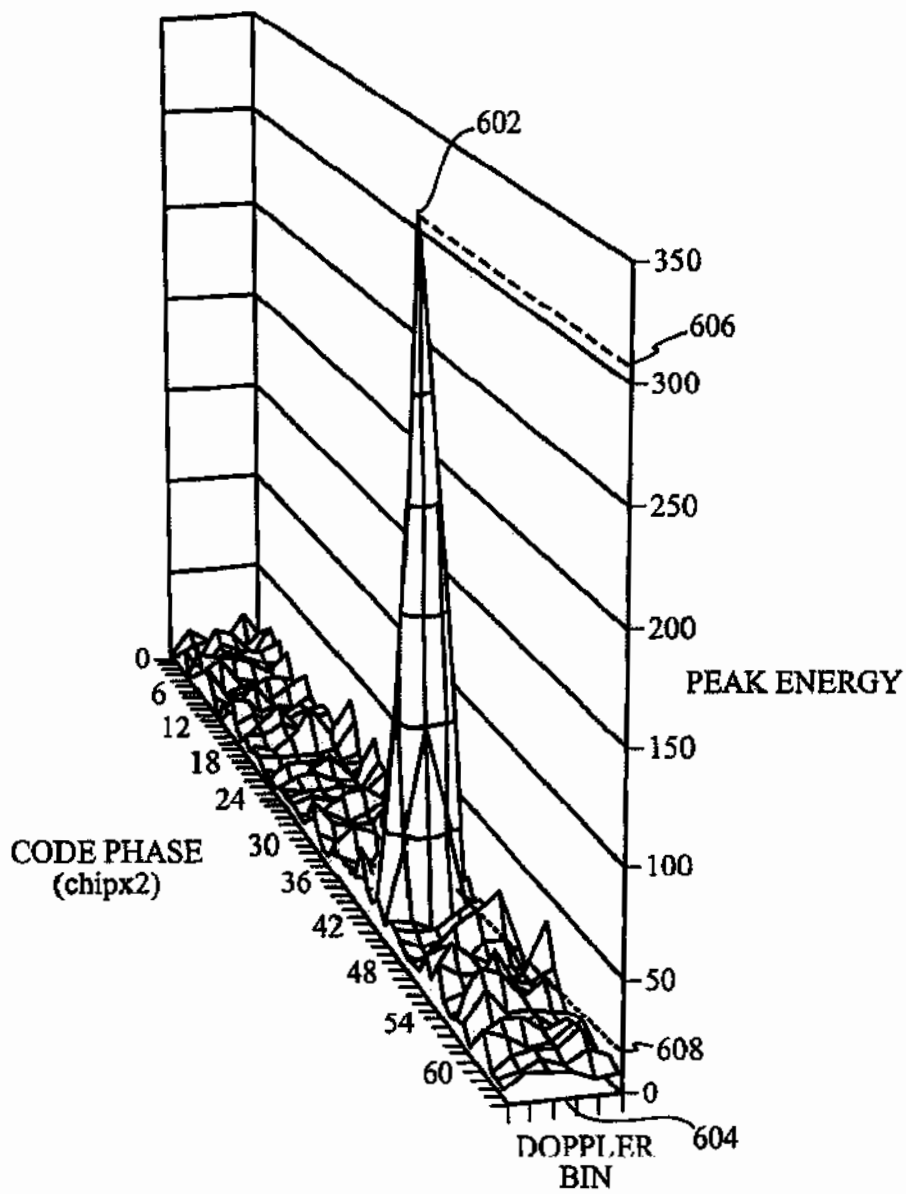

602
350
606
300
250
200
PEAK ENERGY
150
100
50
608
0
604
0
6
12
18
24
30
36
42
48
54
60
CODE PHASE
(chipx2)
DOPPLER
BIN

FIG. 6

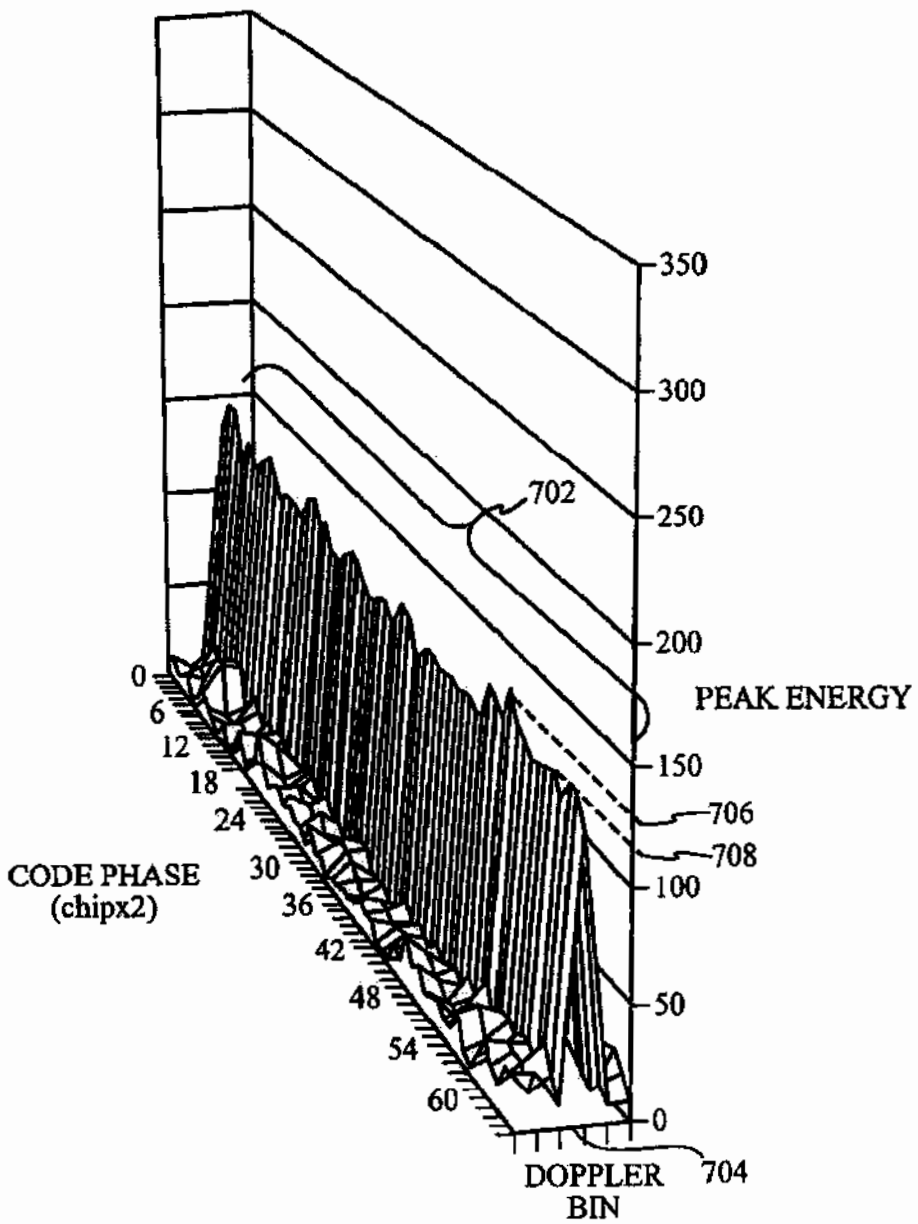

350
300
250
200
PEAK ENERGY
150
100
50
0
702
706
708
704
0
6
12
18
24
30
36
42
48
54
60
CODE PHASE
(chipx2)
DOPPLER
BIN

FIG. 7

```
bool IsJammer() {
802→  calculate subtracted energy sum
804→  if (numRemainingEng <= jamNumEngThresh) return true;
806→  calculate mean measured noise estimate
808→  if (peakHeight < threshLin * meanMeasNoise) return true;
810→  return false;
    }
```

FIG. 8

902

904

SEARCH MODE	COHERENT INTEG (ms)	NON-COH INTEG	TOTAL INTEG TIME(ms)	JAMMER THRESHOLD (dB)	JAMMER THRESHOLD $(LINEAR)^3$
1	20	4	80	16.832	5.910
2	20	44	880	13.718	2.034
3	80	22	1760	15.494	2.795

FIG. 9

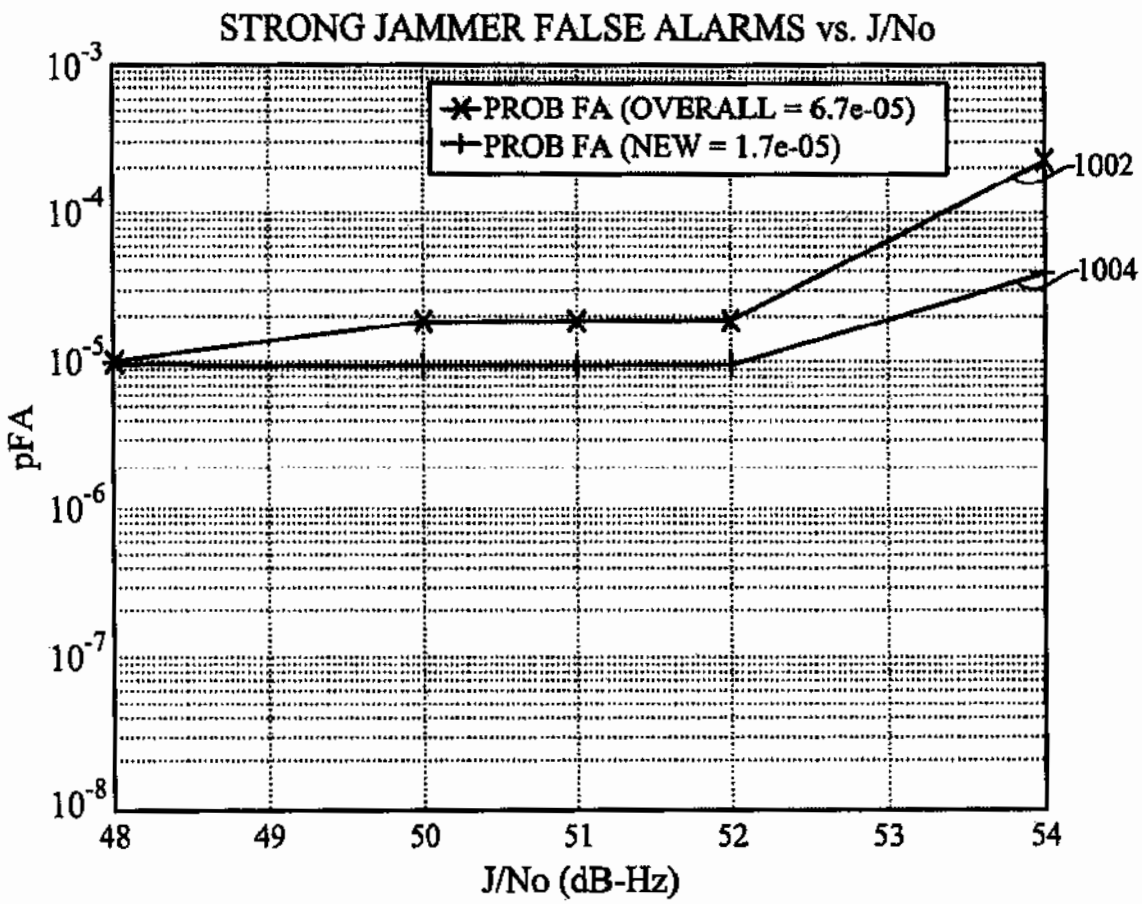

STRONG JAMMER FALSE ALARMS vs. J/No
PROB FA (OVERALL = 6.7e-05)
PROB FA (NEW = 1.7e-05)
1002
1004
pFA
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
48
49
50
51
52
53
54
J/No (dB-Hz)

FIG. 10

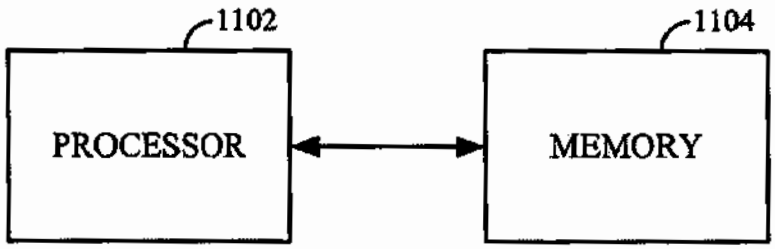


FIG. 11

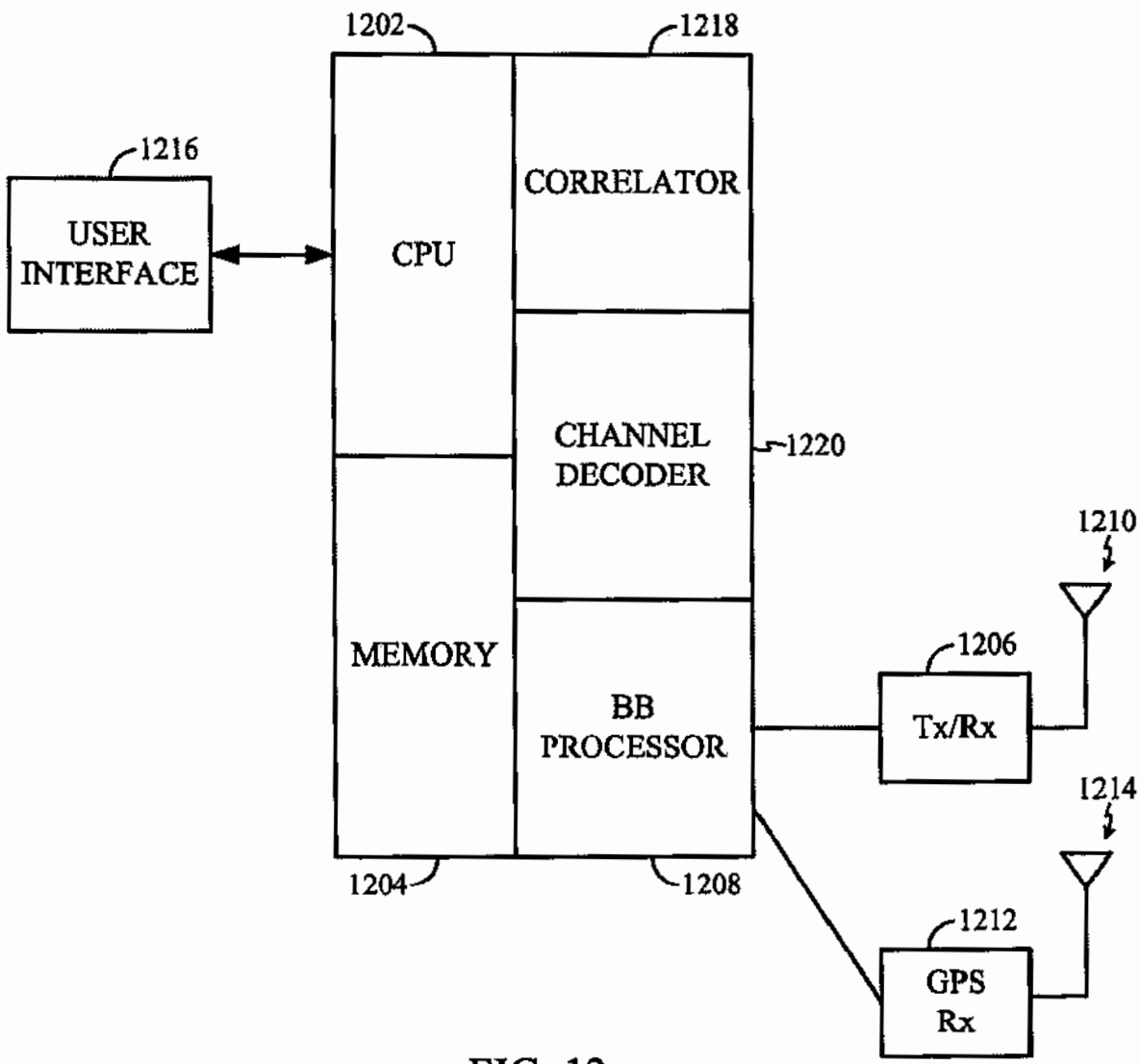

1202
1218
1216
USER INTERFACE
CPU
CORRELATOR
CHANNEL DECODER
1220
MEMORY
BB PROCESSOR
1210
1206
Tx/Rx
1214
1212
GPS Rx
1204
1208

FIG. 12