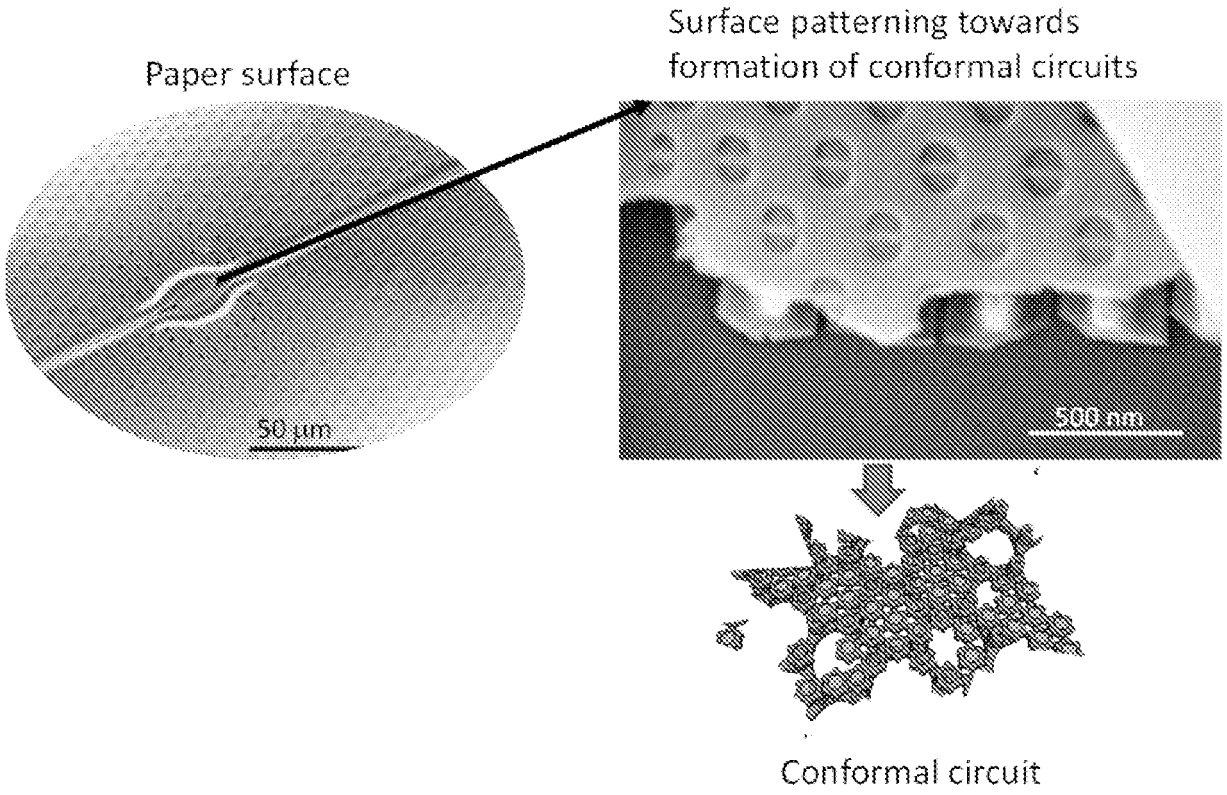
Surface patterning towards
formation of conformal circuits
Paper surface
50 µm
500 nm
Conformal circuit

FIG. 1

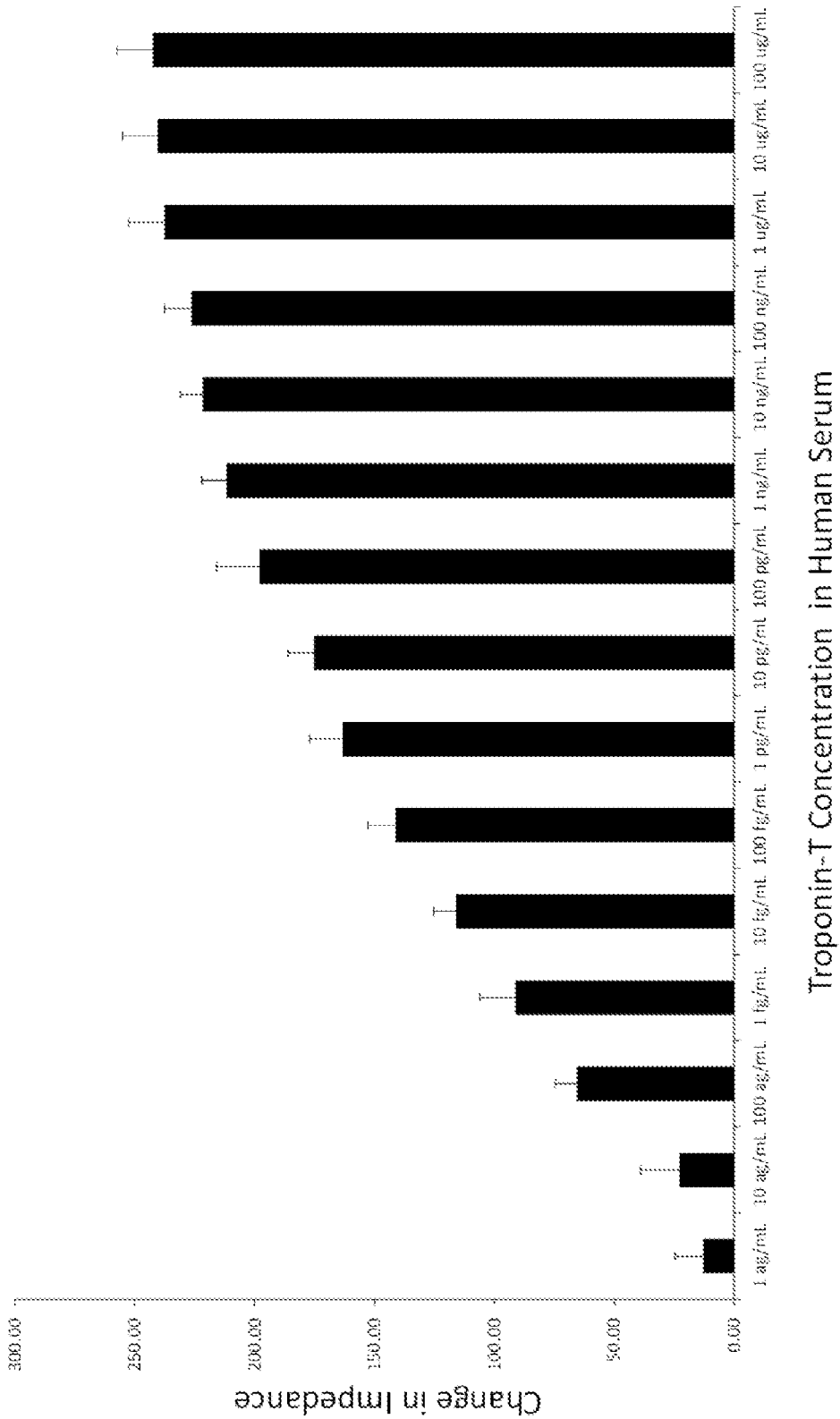
Troponin-T Concentration in Human Serum
Change in Impedance
300.00
250.00
200.00
150.00
100.00
50.00
0.00
1 ag/mL
10 ag/mL
100 ag/mL
1 fg/mL
10 fg/mL
100 fg/mL
1 pg/mL
10 pg/mL
100 pg/mL
1 ng/mL
10 ng/mL
100 ng/mL
1 ug/mL
10 ug/mL
100 ug/mL

FIG. 2

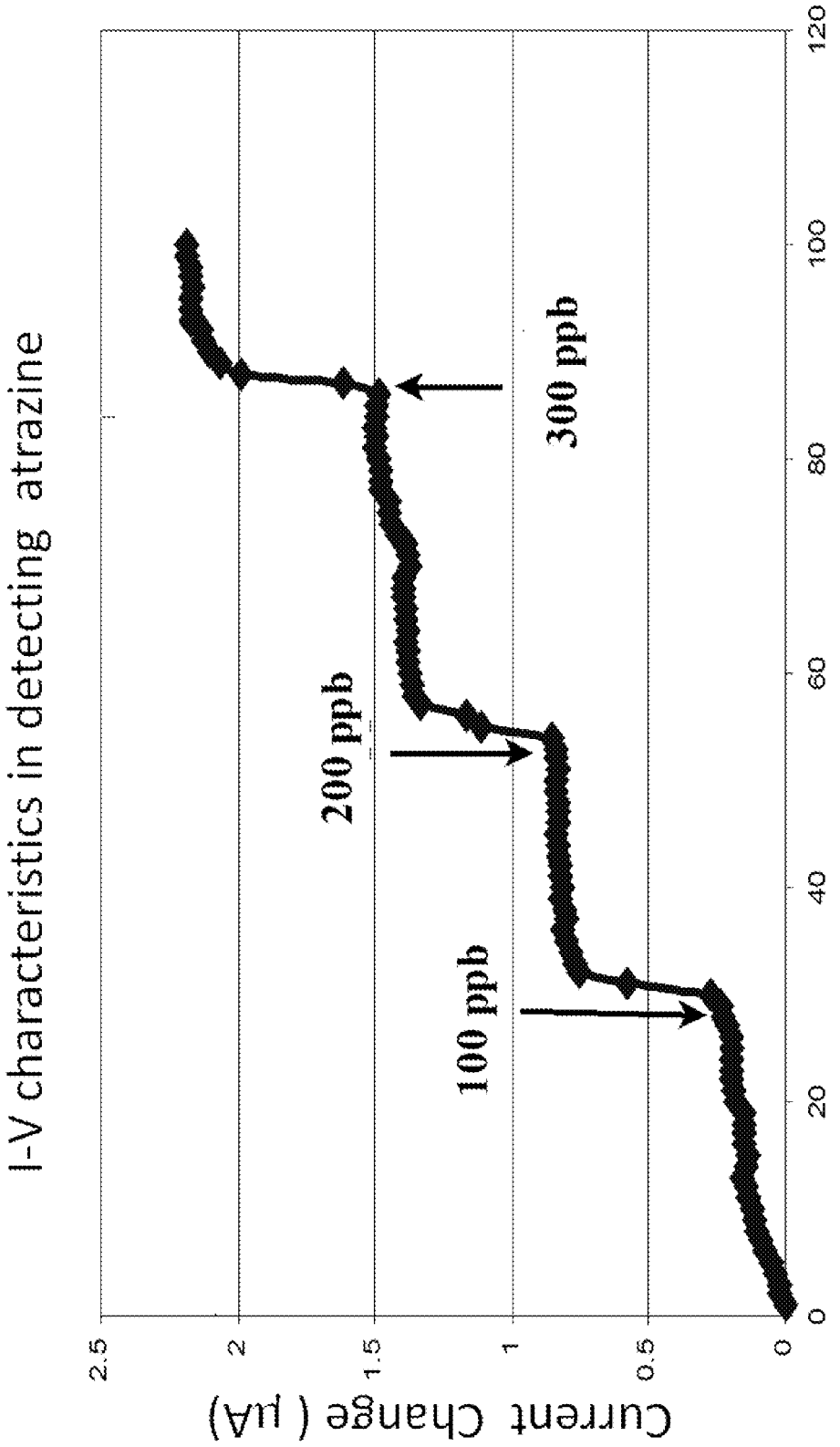
I-V characteristics in detecting atrazine
Current Change (μA)
Voltage (mV)
0
0.5
1
1.5
2
2.5
0
20
40
60
80
100
120
100 ppb
200 ppb
300 ppb

FIG. 3

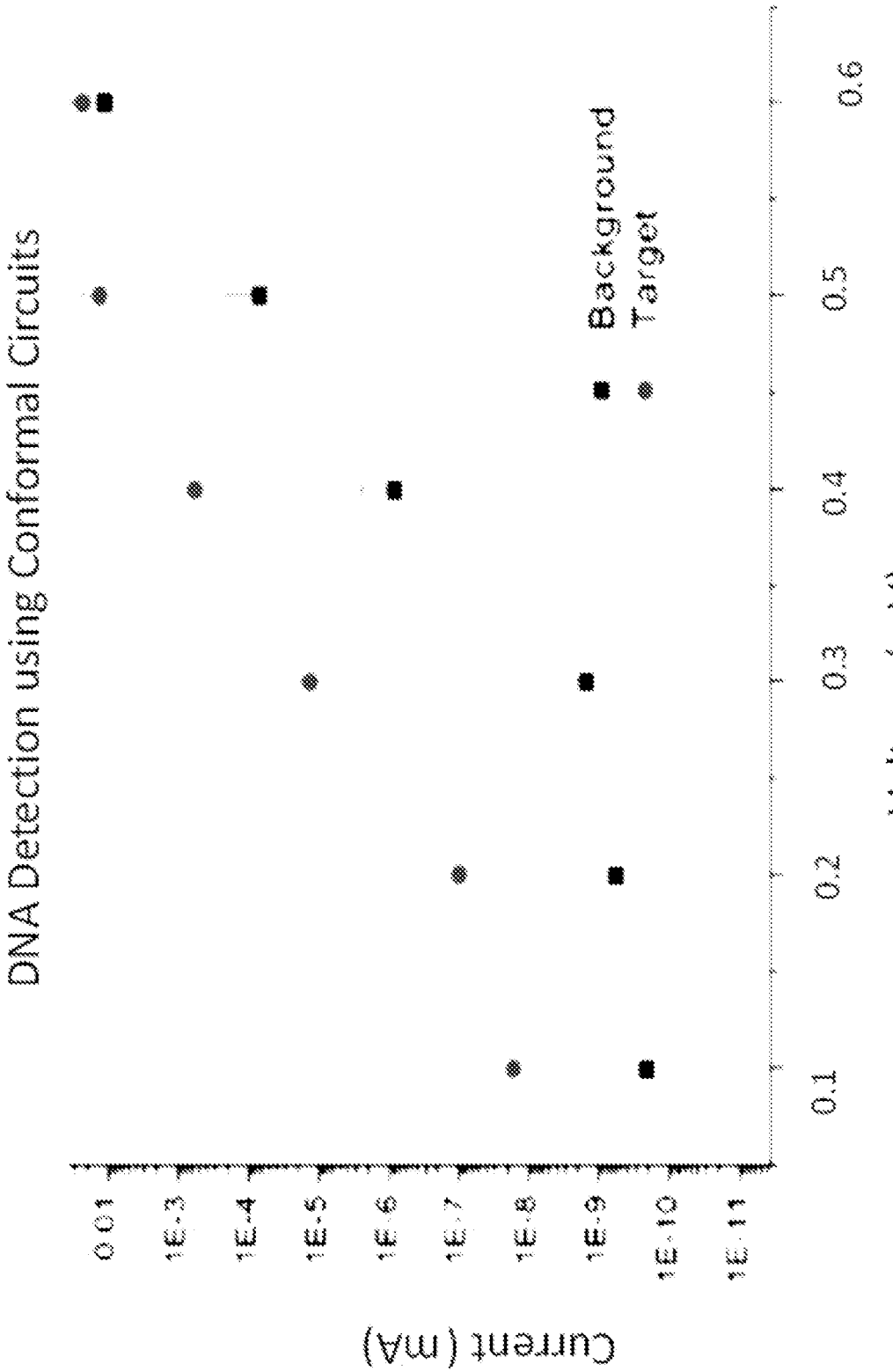
DNA Detection using Conformal Circuits
Background
Target
Current (mA)
0.01
1E-3
1E-4
1E-5
1E-6
1E-7
1E-8
1E-9
1E-10
1E-11
0.1
0.2
0.3
0.4
0.5
0.6
Voltage (mV)

FIG. 4

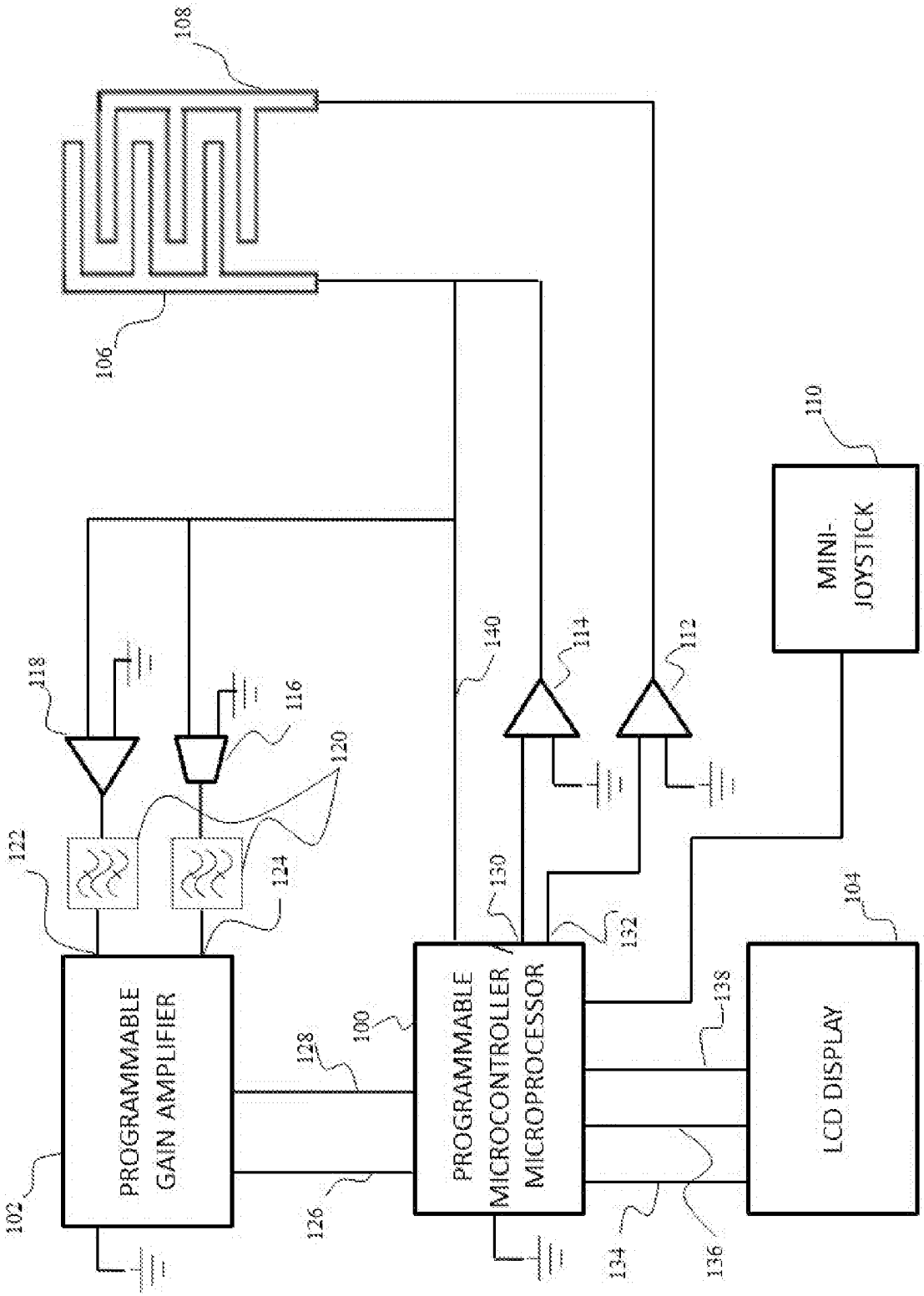
108
106
110
MINI-
JOYSTICK
140
114
112
118
116
120
122
124
130
132
104
PROGRAMMABLE
GAIN AMPLIFIER
128
100
PROGRAMMABLE
MICROCONTROLLER
MICROPROCESSOR
138
LCD DISPLAY
102
126
134
136

FIG. 5

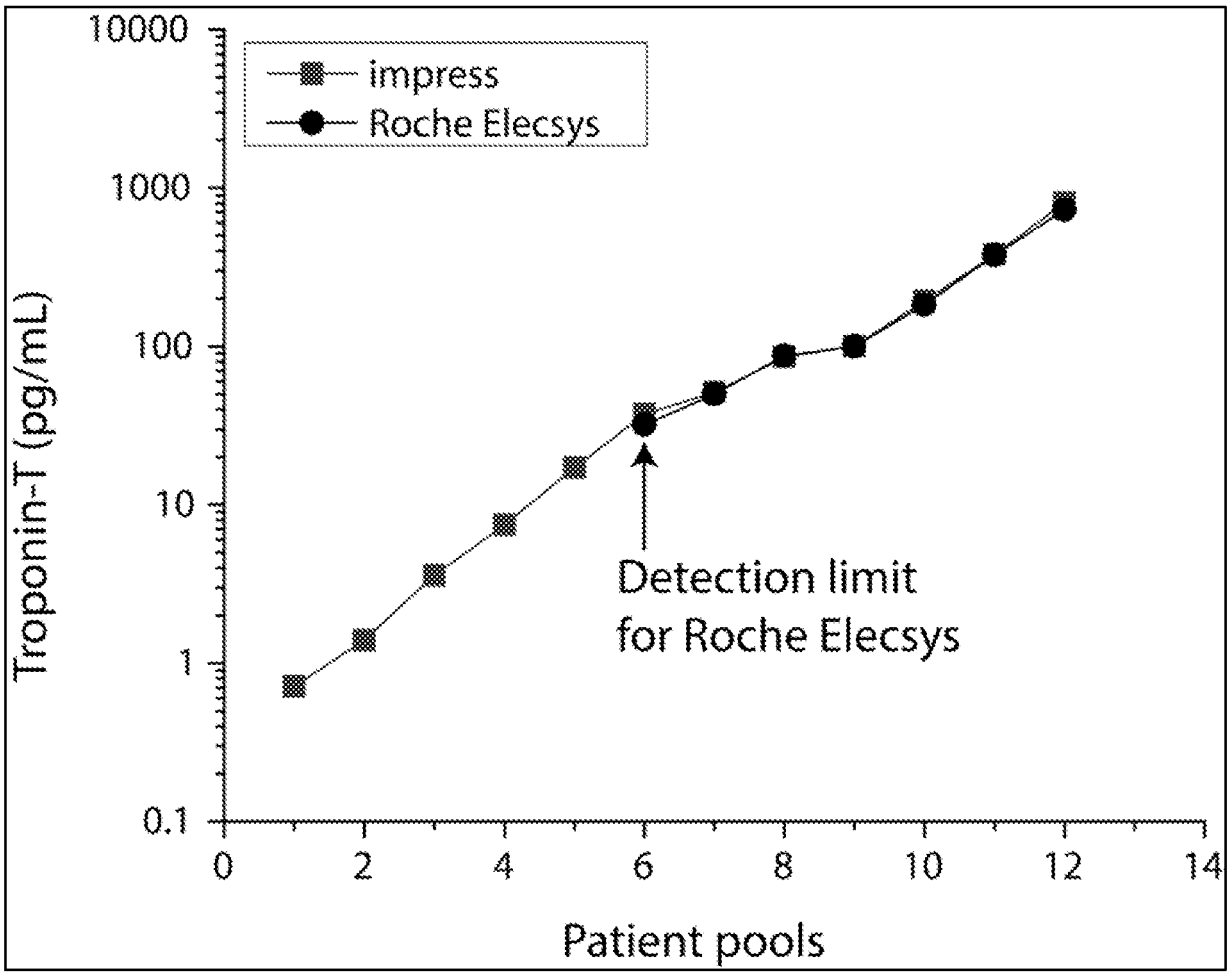
10000
1000
100
10
1
0.1
Troponin-T (pg/mL)
impress
Roche Elecsys
Detection limit
for Roche Elecsys
0
2
4
6
8
10
12
14
Patient pools

FIG. 6

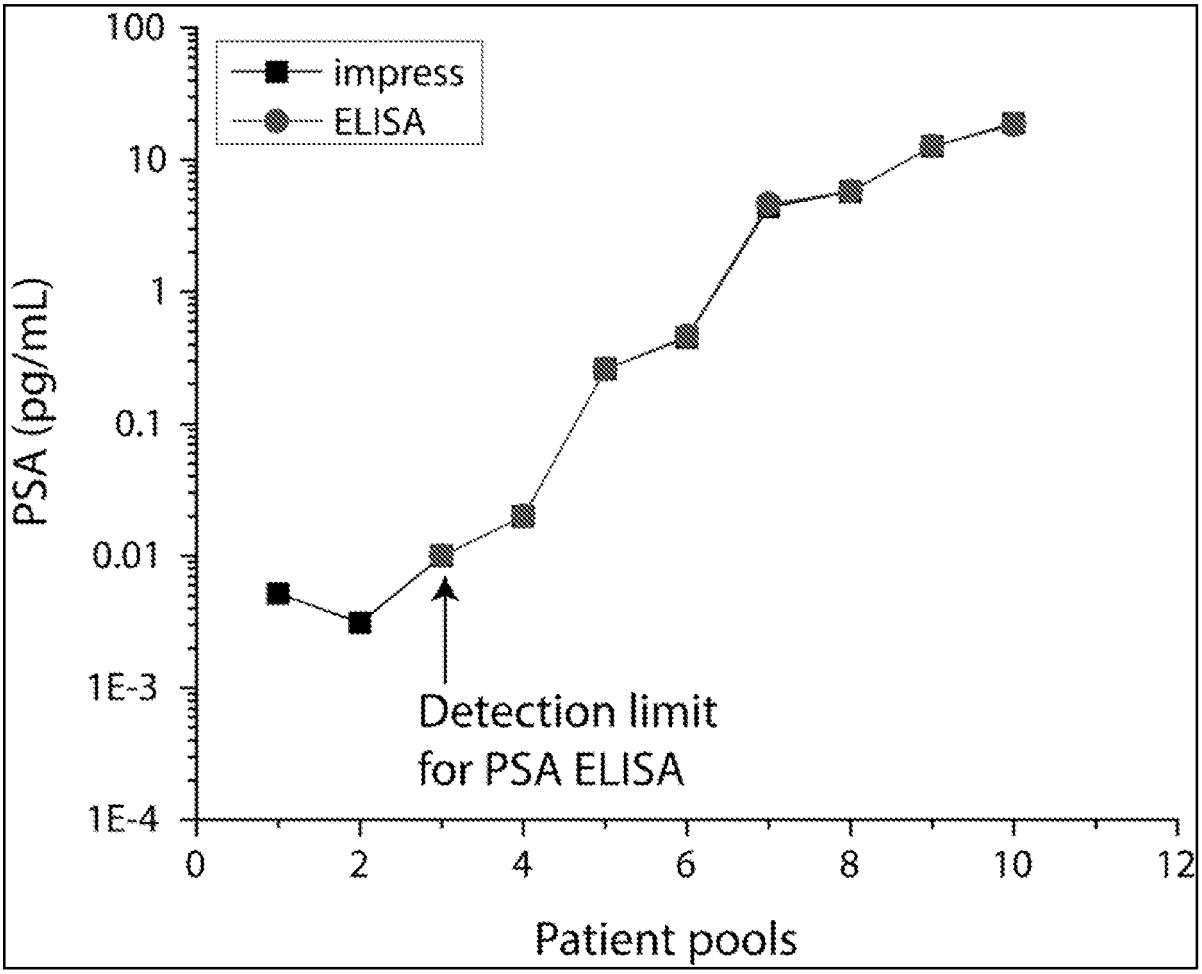
100
10
1
0.1
0.01
1E-3
1E-4
PSA (pg/mL)
impress
ELISA
Detection limit
for PSA ELISA
0
2
4
6
8
10
12
Patient pools

FIG. 7

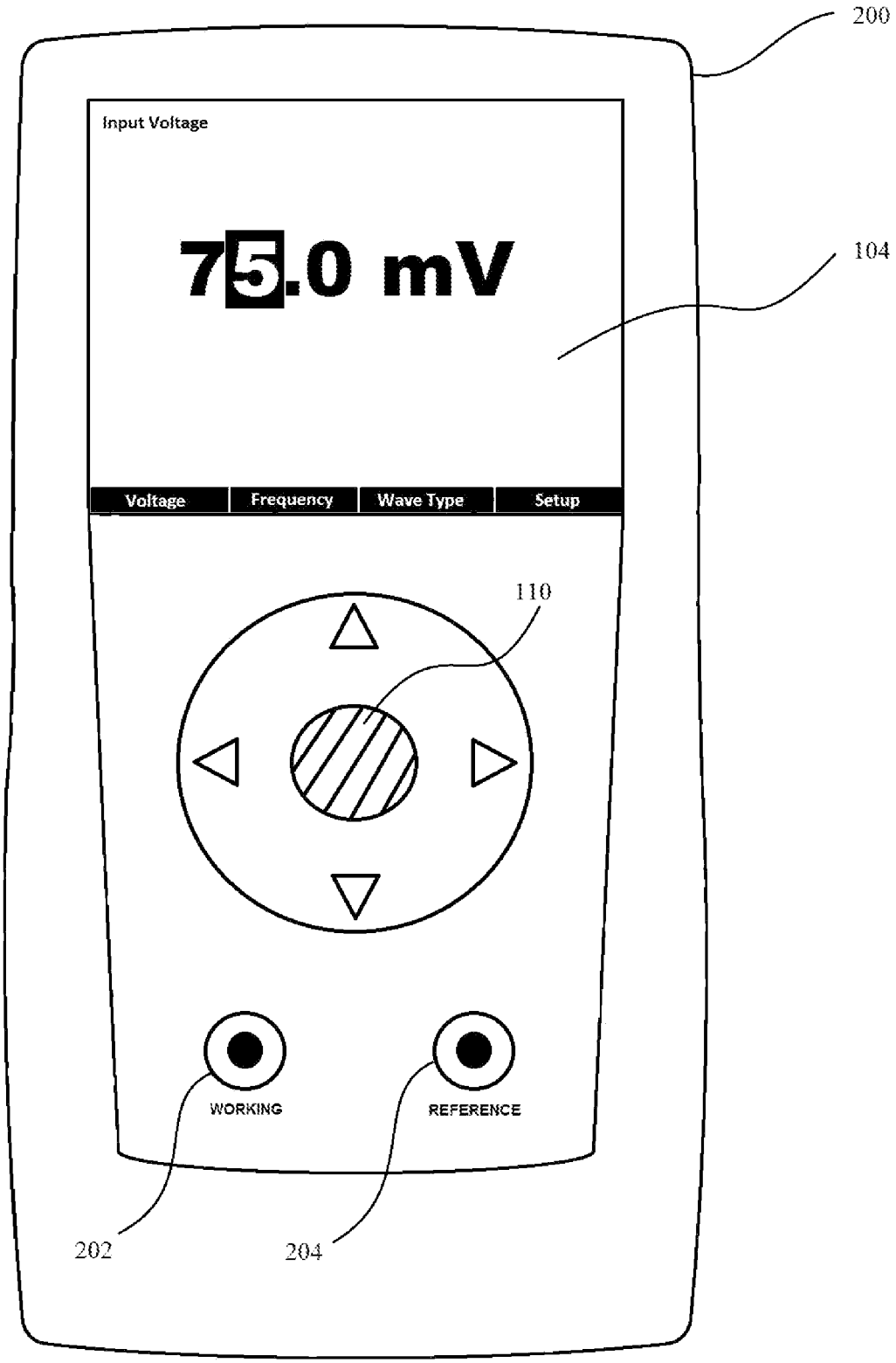
200
Input Voltage
75.0 mV
104
Voltage
Frequency
Wave Type
Setup
110
WORKING
REFERENCE
202
204

FIG. 8

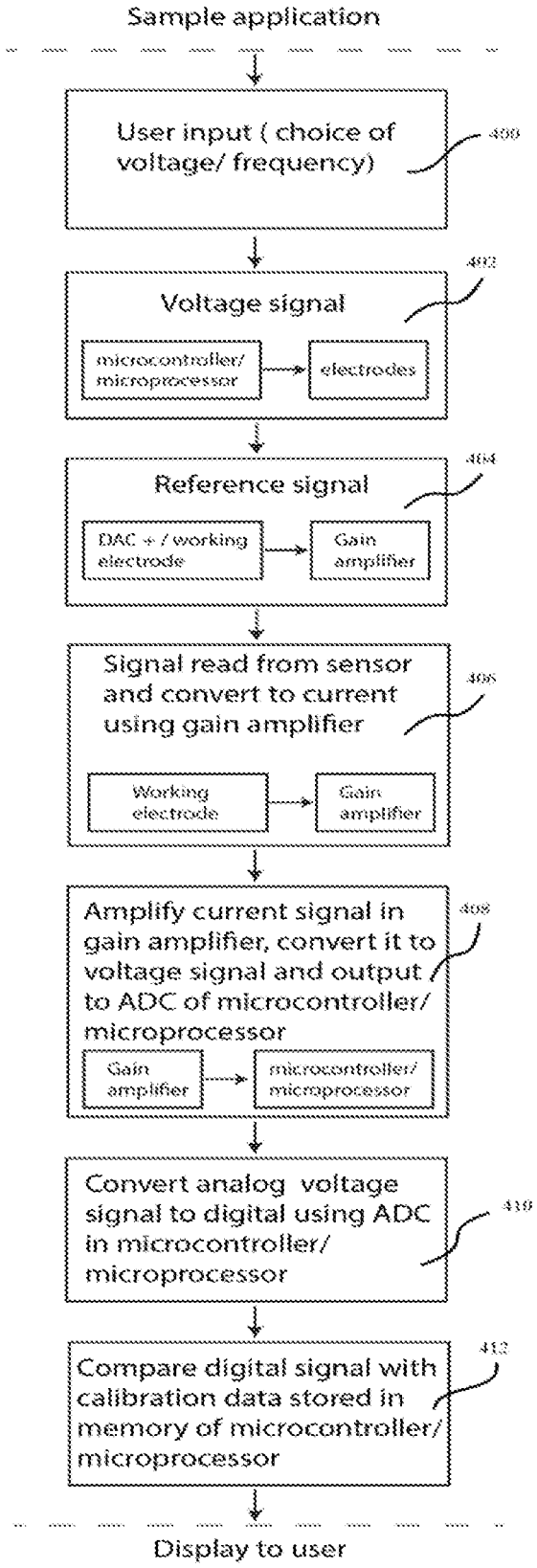
Sample application
User input (choice of voltage/ frequency)
400
Voltage signal
microcontroller/ microprocessor
electrodes
402
Reference signal
DAC + / working electrode
Gain amplifier
404
Signal read from sensor and convert to current using gain amplifier
Working electrode
Gain amplifier
406
Amplify current signal in gain amplifier, convert it to voltage signal and output to ADC of microcontroller/ microprocessor
Gain amplifier
microcontroller/ microprocessor
408
Convert analog voltage signal to digital using ADC in microcontroller/ microprocessor
410
Compare digital signal with calibration data stored in memory of microcontroller/ microprocessor
412
Display to user

FIG. 9

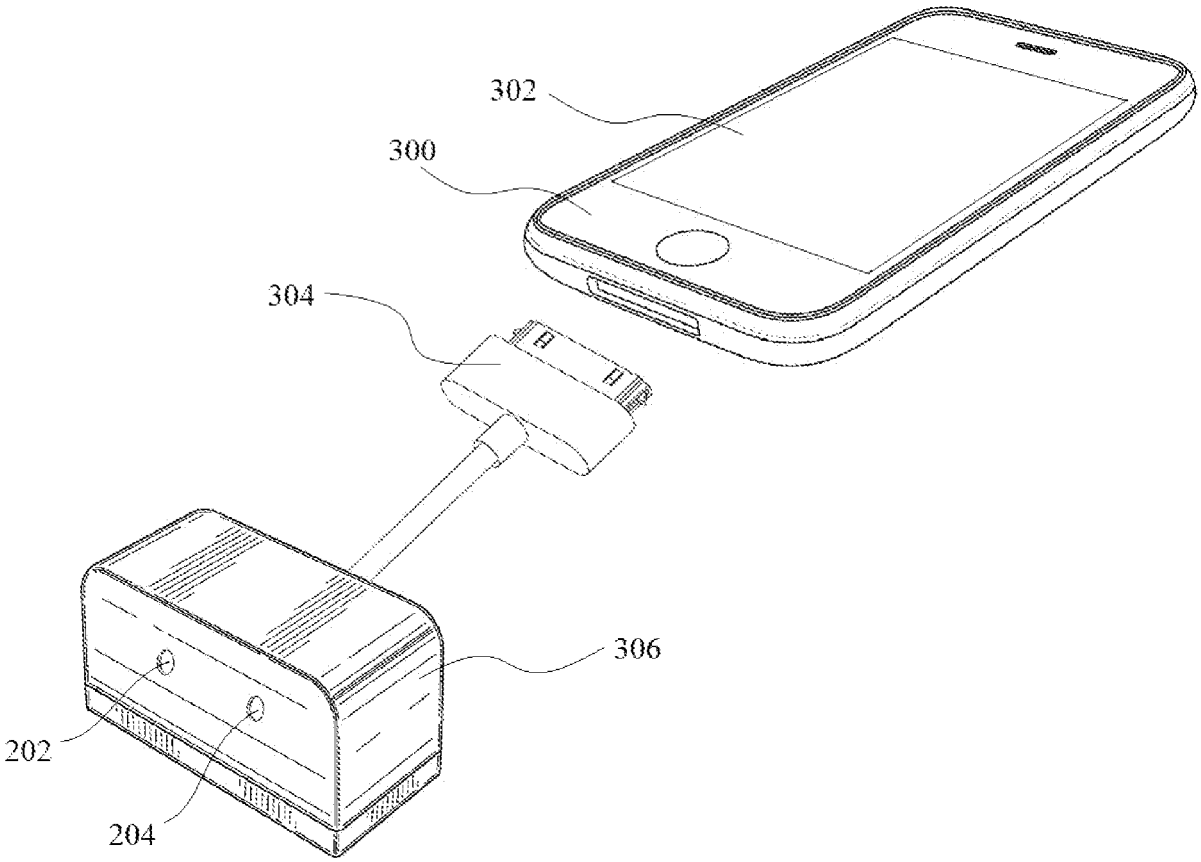

FIG. 10

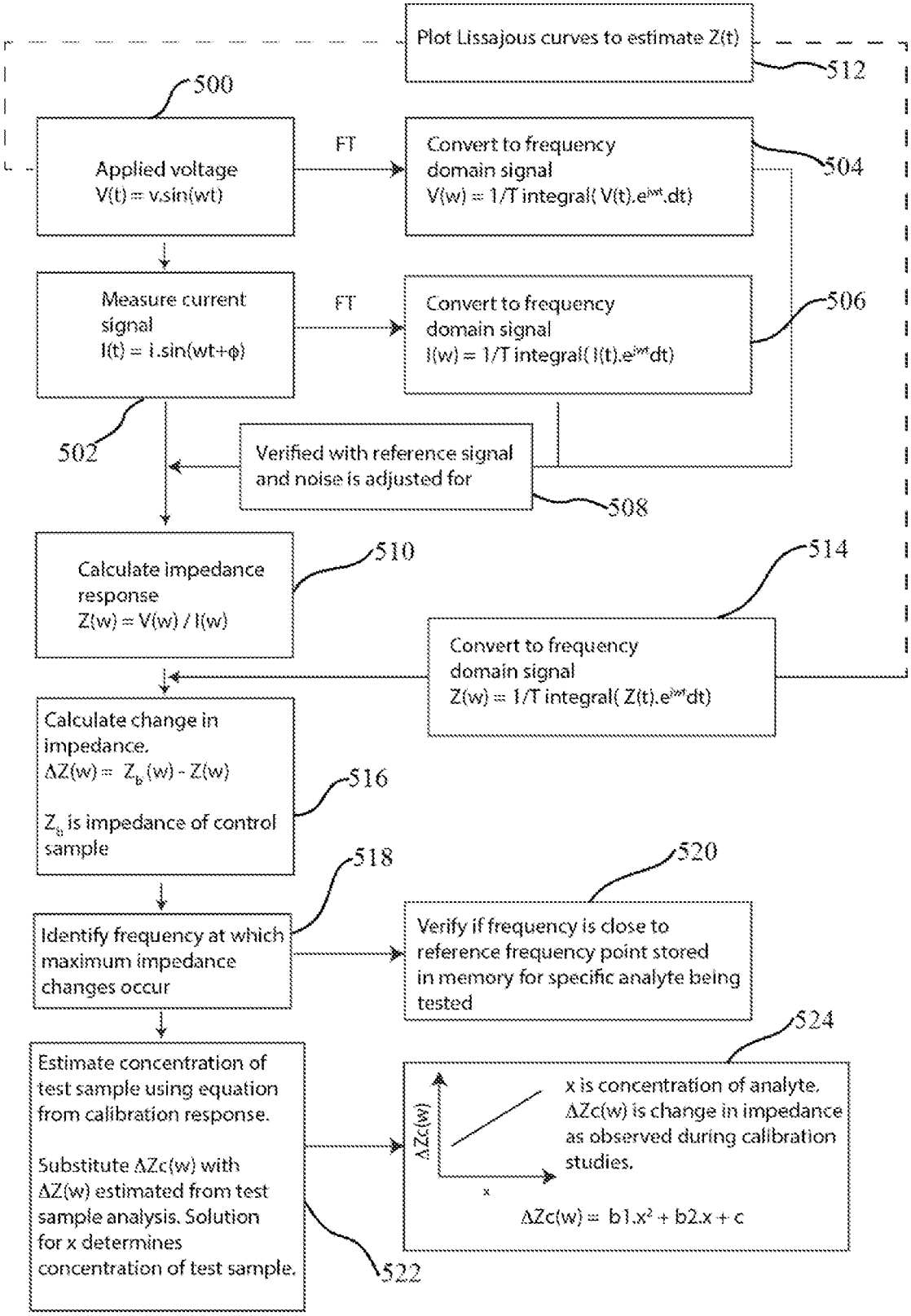
Plot Lissajous curves to estimate Z(t)
512
500
Applied voltage
V(t) = v.sin(wt)
FT
Convert to frequency domain signal
V(w) = 1/T integral(V(t).e^jwt.dt)
504
Measure current signal
I(t) = i.sin(wt+ϕ)
FT
Convert to frequency domain signal
I(w) = 1/T integral(I(t).e^jwt dt)
506
502
Verified with reference signal and noise is adjusted for
508
Calculate impedance response
Z(w) = V(w) / I(w)
510
514
Convert to frequency domain signal
Z(w) = 1/T integral(Z(t).e^jwt dt)
Calculate change in impedance.
ΔZ(w) = Z_b(w) - Z(w)
Z_b is impedance of control sample
516
518
520
Identify frequency at which maximum impedance changes occur
Verify if frequency is close to reference frequency point stored in memory for specific analyte being tested
524
Estimate concentration of test sample using equation from calibration response.
Substitute ΔZc(w) with ΔZ(w) estimated from test sample analysis. Solution for x determines concentration of test sample.
522
ΔZc(w)
x
x is concentration of analyte. ΔZc(w) is change in impedance as observed during calibration studies.
ΔZc(w) = b1.x² + b2.x + c

FIG. 11

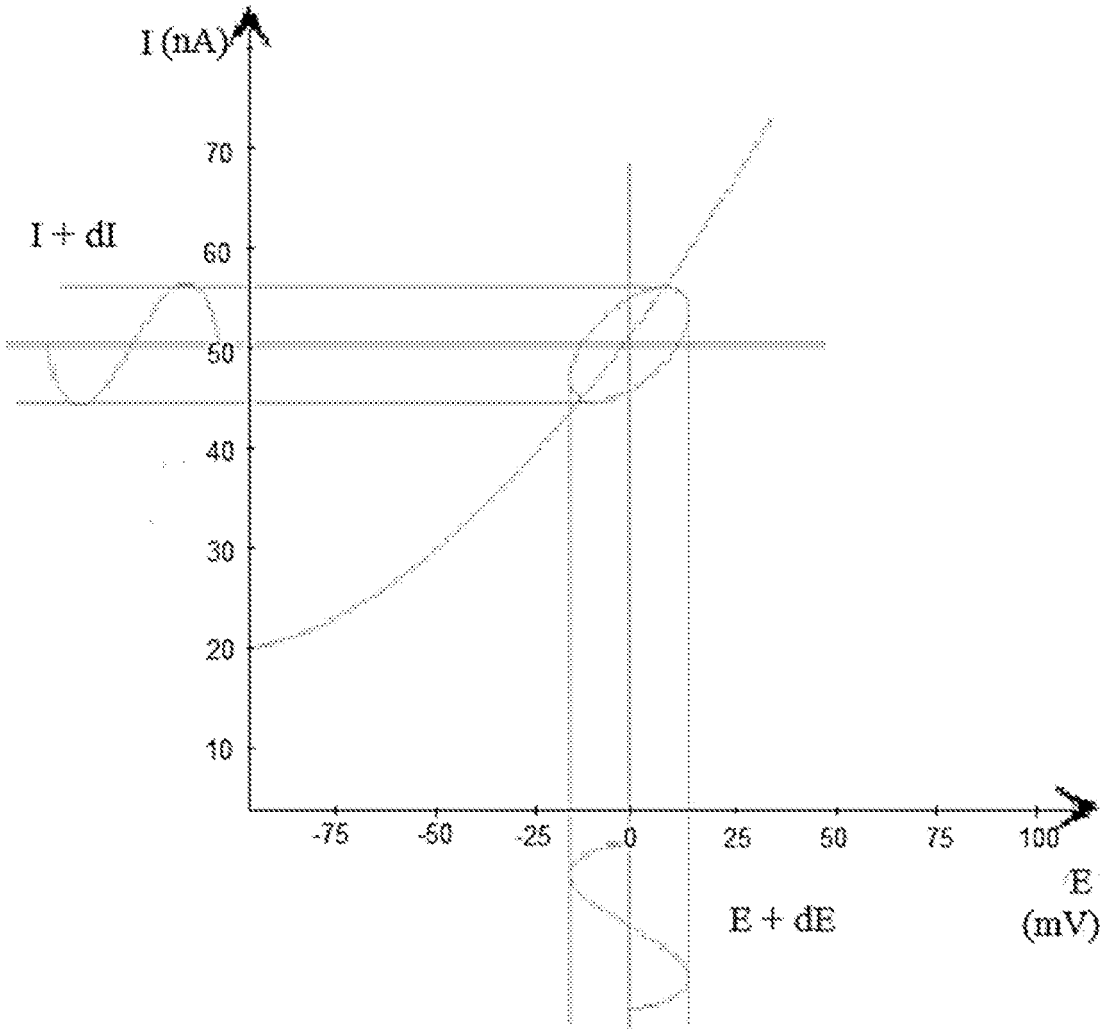

FIG. 12