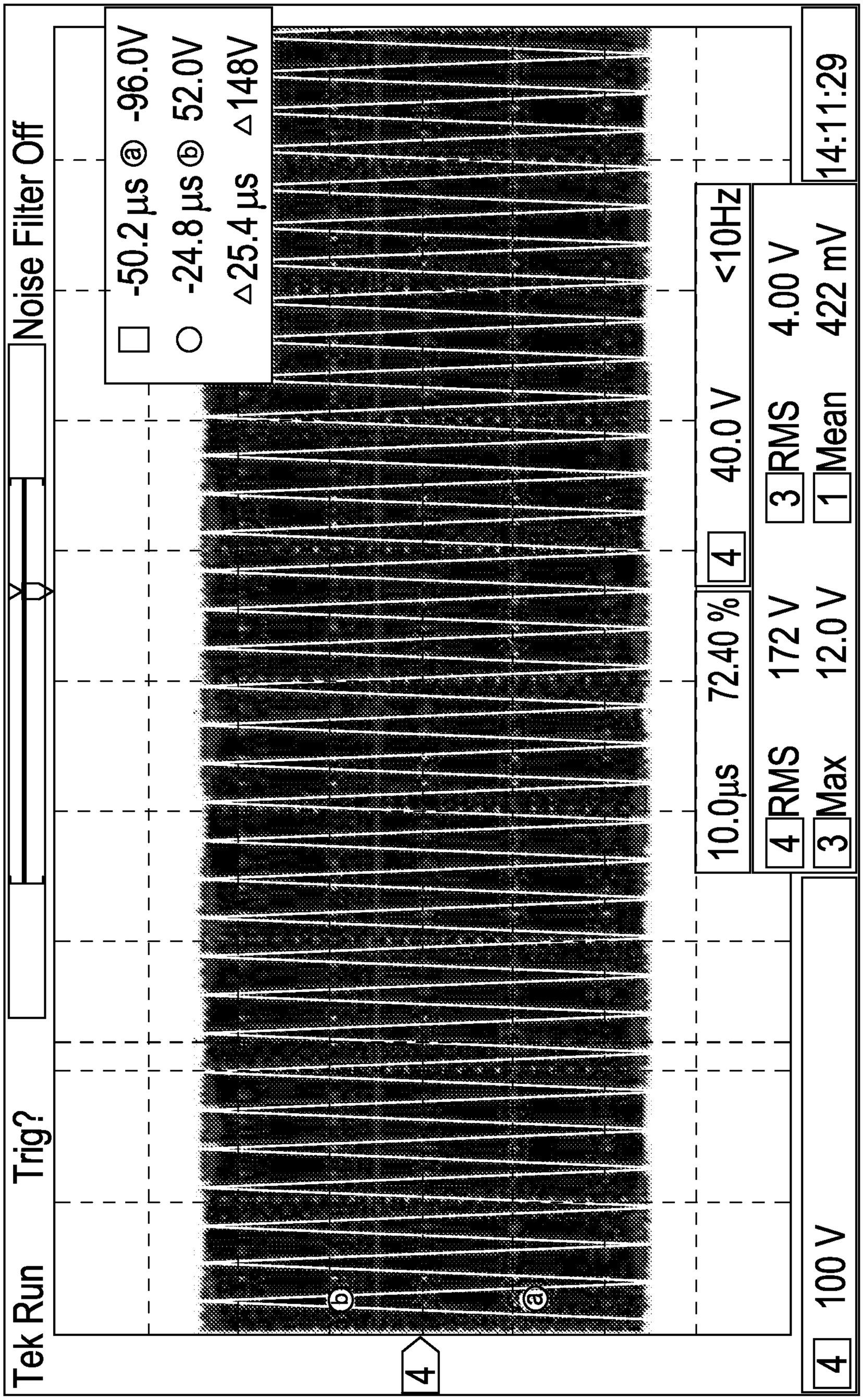

Noise Filter Off
-50.2 µs @ -96.0V
-24.8 µs @ 52.0V
Δ25.4 µs Δ148V
14:11:29
Trig?
10.0µs 72.40 % 4 40.0 V <10Hz
4 RMS 172 V 3 RMS 4.00 V
3 Max 12.0 V 1 Mean 422 mV
Tek Run
4 100 V
a
b
4

FIG. 1

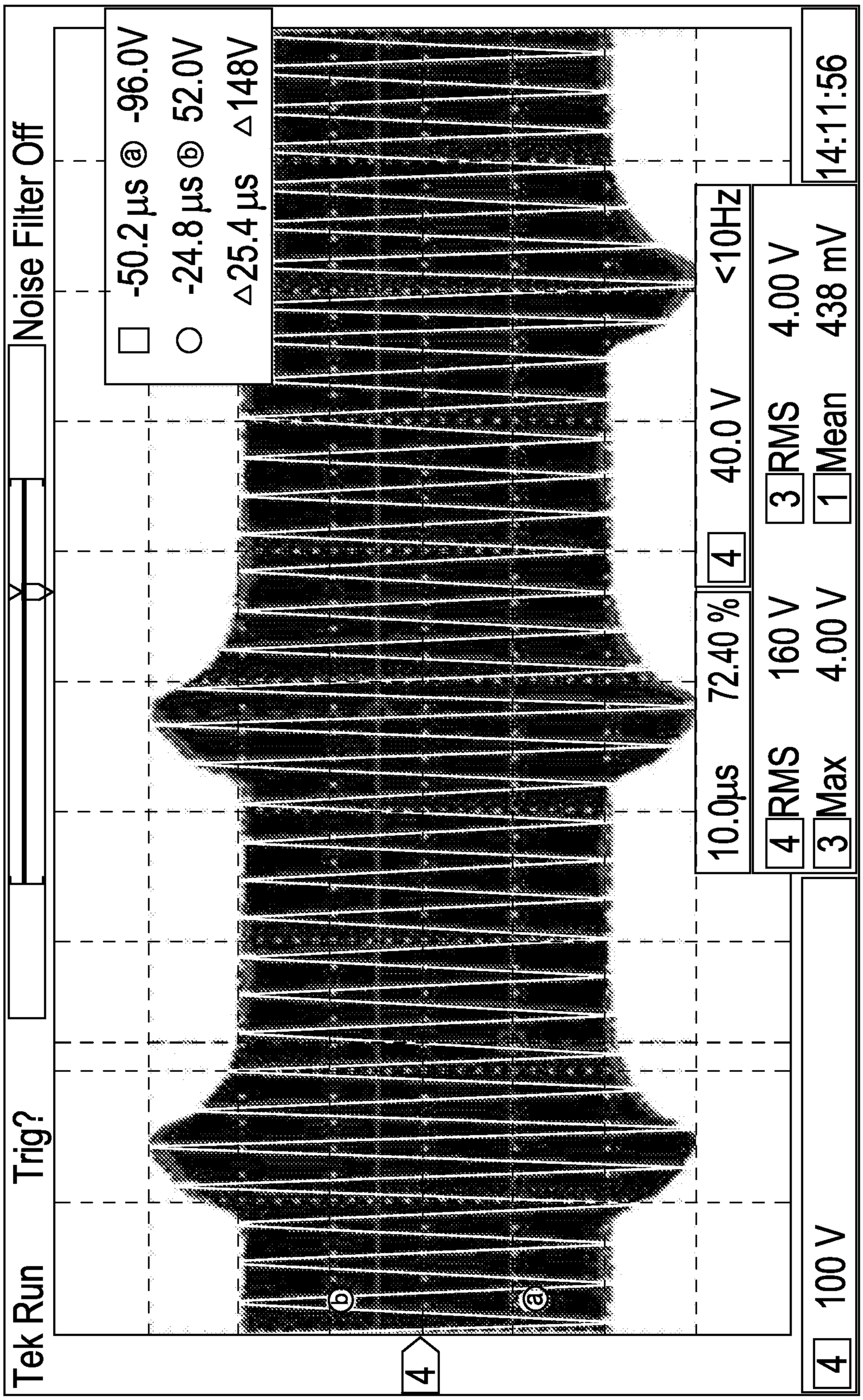

Noise Filter Off
-50.2 µs @ -96.0V
-24.8 µs @ 52.0V
Δ25.4 µs Δ148V
14:11:56
10.0µs 72.40 %
4 RMS 160 V
3 Max 4.00 V
4 40.0 V <10Hz
3 RMS 4.00 V
1 Mean 438 mV
Trig?
Tek Run
b
a
4
4 100 V

FIG. 2

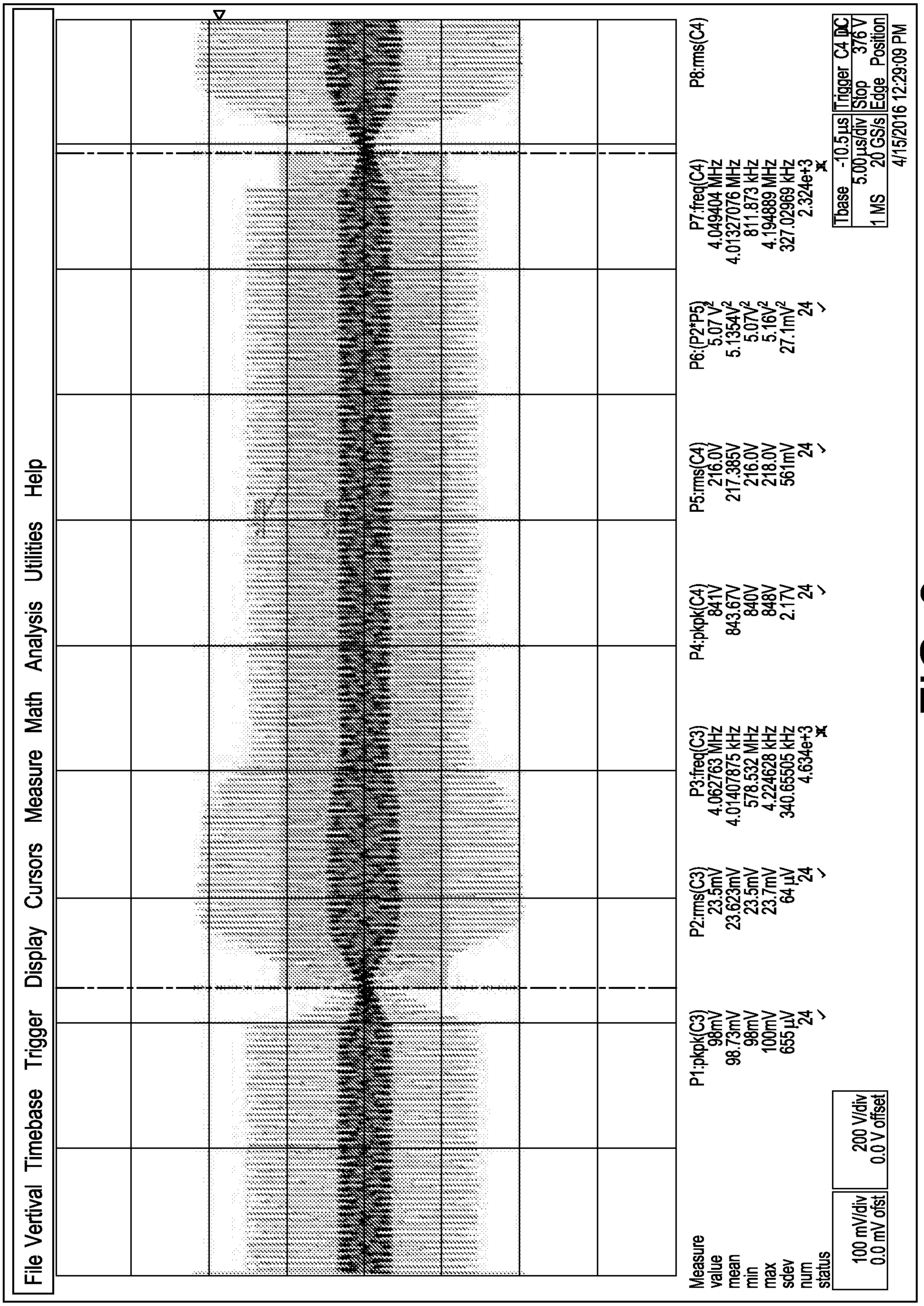

File Vertival Timebase Trigger Display Cursors Measure Math Analysis Utilities Help
Measure
value
mean
min
max
sdev
num
status
P1:pkpk(C3)
98mV
98.73mV
98mV
100mV
655 µV
24
100 mV/div
0.0 mV ofst
200 V/div
0.0 V offset
P2:rms(C3)
23.5mV
23.623mV
23.5mV
23.7mV
64 µV
24
P3:freq(C3)
4.062763 MHz
4.01407875 kHz
578.532 MHz
4.224628 kHz
340.65505 kHz
4.634e+3
P4:pkpk(C4)
841V
843.67V
840V
848V
2.17V
24
P5:rms(C4)
216.0V
217.385V
216.0V
218.0V
561mV
24
P6:(P2*P5)
5.07 V²
5.1354V²
5.07V²
5.16V²
27.1mV²
24
P7:freq(C4)
4.049404 MHz
4.01327076 MHz
811.873 kHz
4.194889 MHz
327.02969 kHz
2.324e+3
P8:ms(C4)
Trigger C4 DC
Stop 376 V
Edge Position
-10.5µs
5.00µs/div
20 GS/s
1 MS
Tbase
4/15/2016 12:29:09 PM

FIG. 3

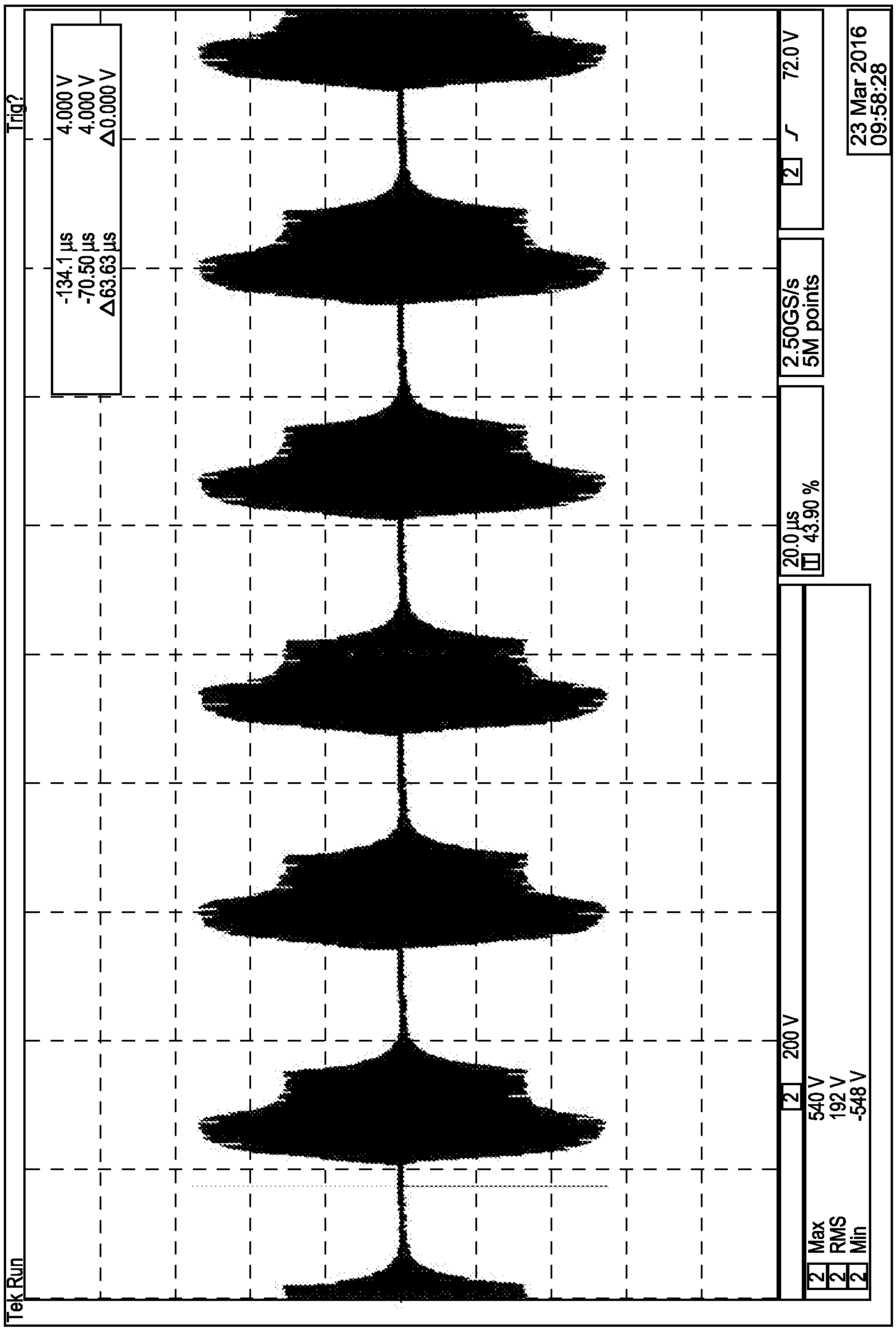

Trig?
4.000 V
4.000 V
Δ0.000 V
-134.1 µs
-70.50 µs
Δ63.63 µs
72.0 V
2
2.50GS/s
5M points
20.0 µs
43.90 %
200 V
2
540 V
192 V
-548 V
Max
RMS
Min
23 Mar 2016
09:58:28
Tek Run

FIG. 4

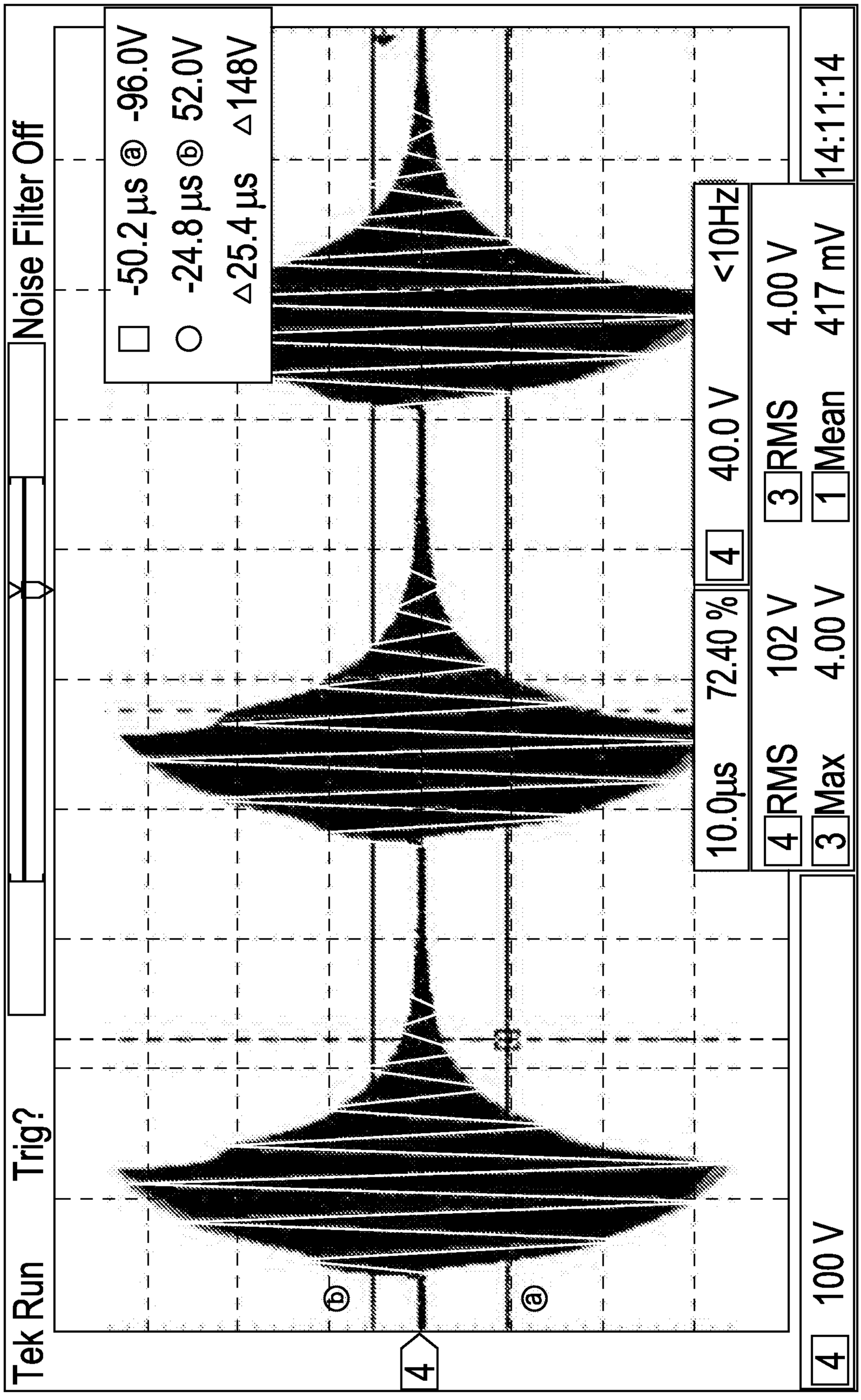

Noise Filter Off
-50.2 µs @ -96.0V
-24.8 µs @ 52.0V
Δ25.4 µs Δ148V
10.0µs 72.40 % 4 40.0 V <10Hz
4 RMS 102 V 3 RMS 4.00 V
3 Max 4.00 V 1 Mean 417 mV
14:11:14
Tek Run Trig?
4
ⓑ
ⓐ
4 100 V

FIG. 5

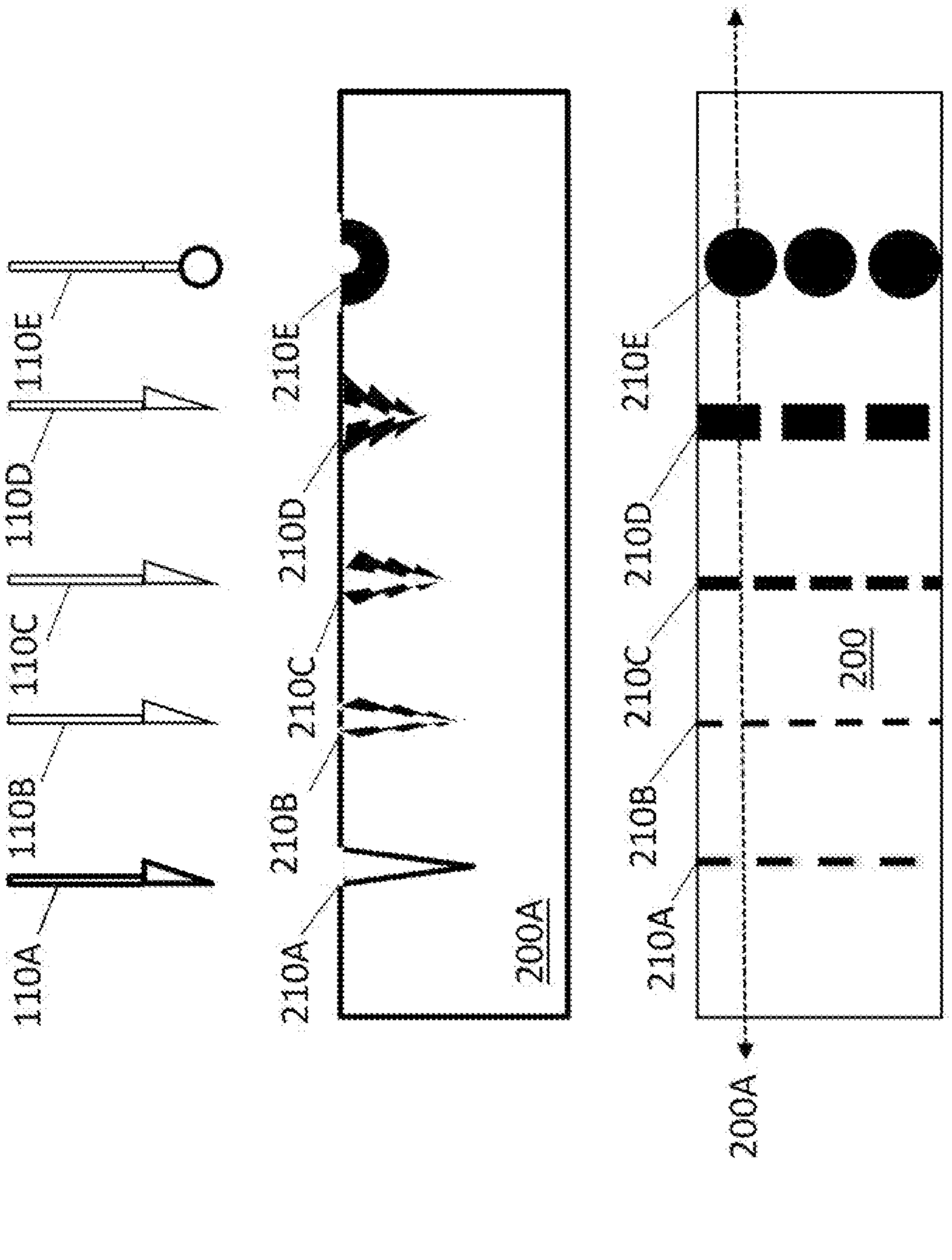

110A
110B
110C
110D
110E
210A
210B
210C
210D
210E
200A
200
200A

FIG. 6

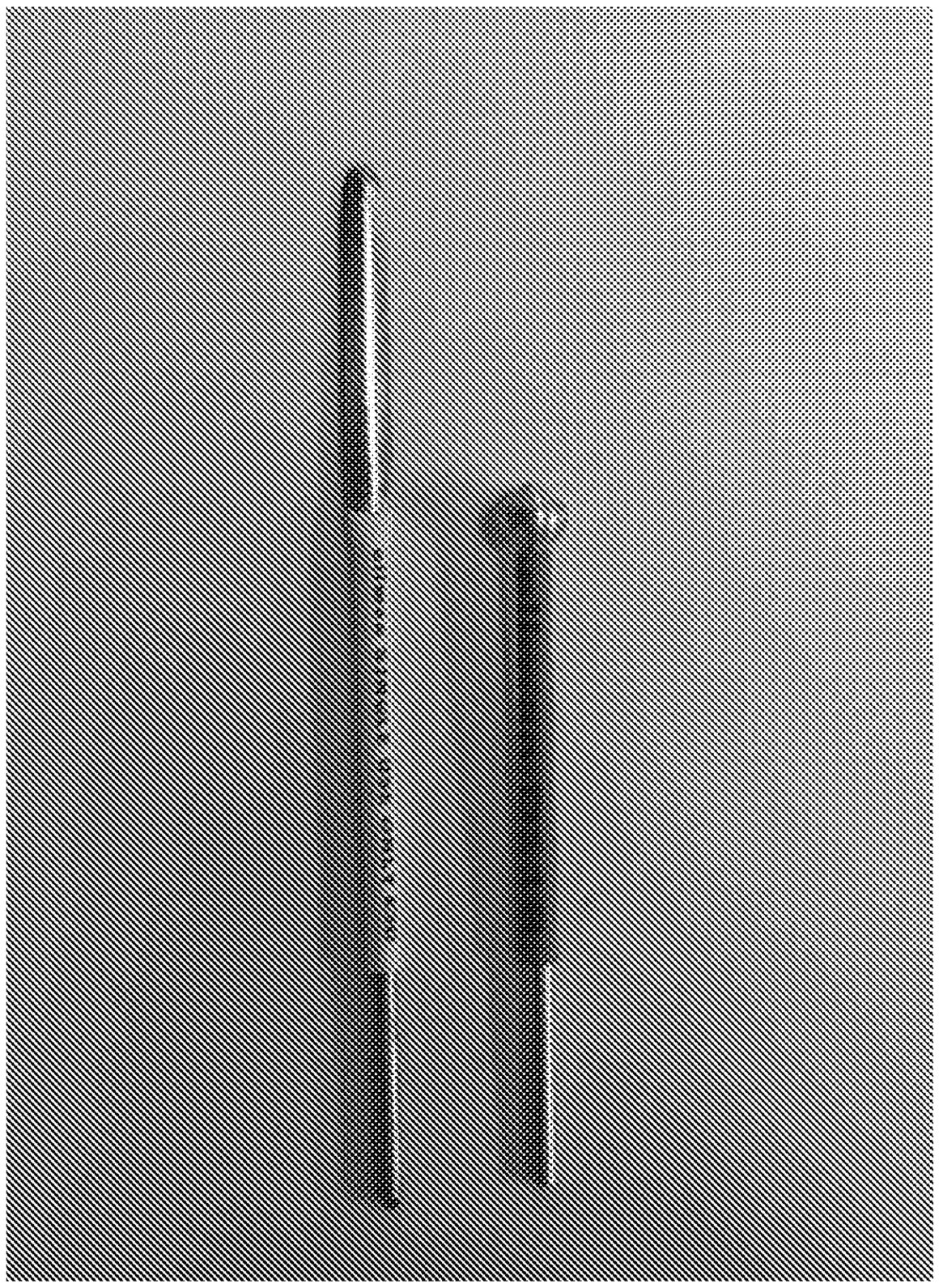


FIG. 7

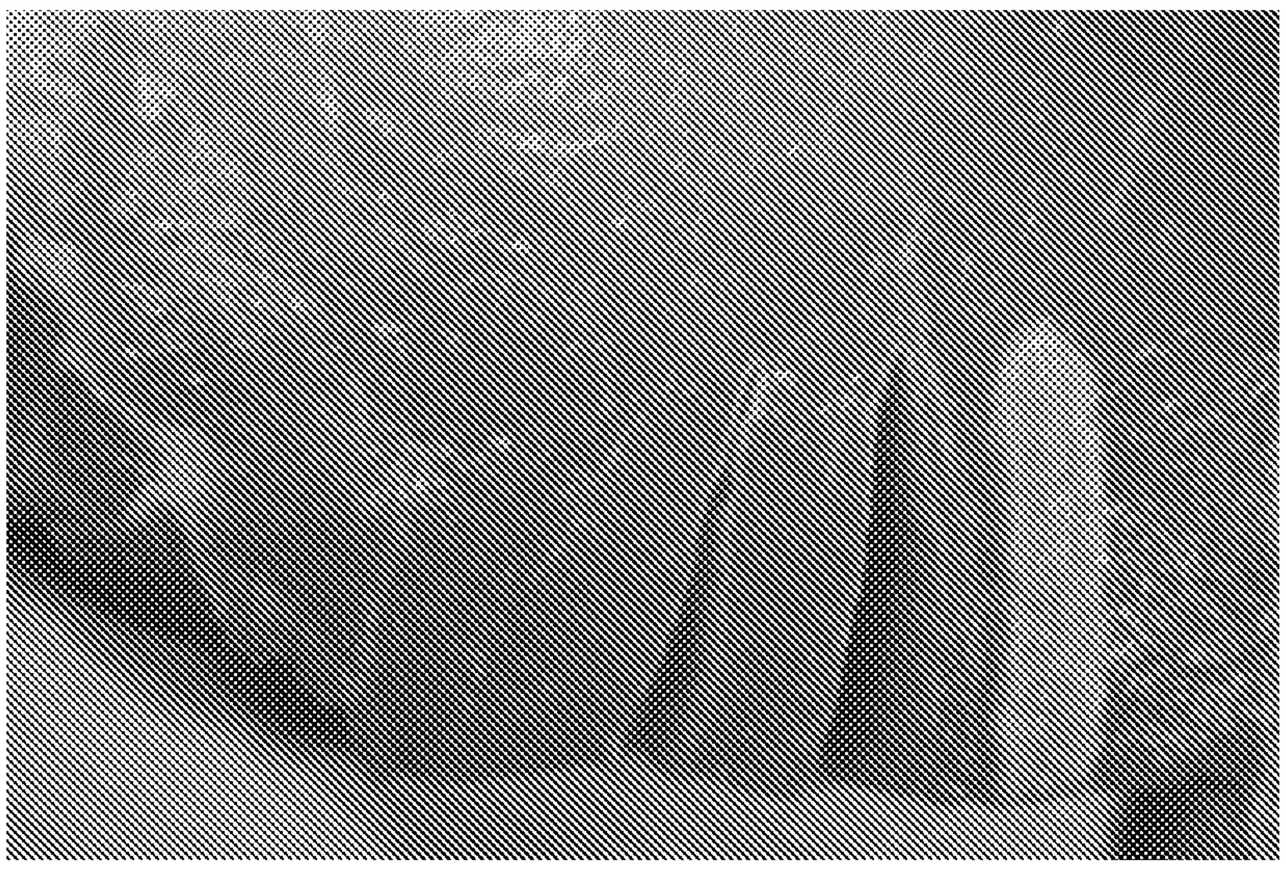


FIG. 8



FIG. 10

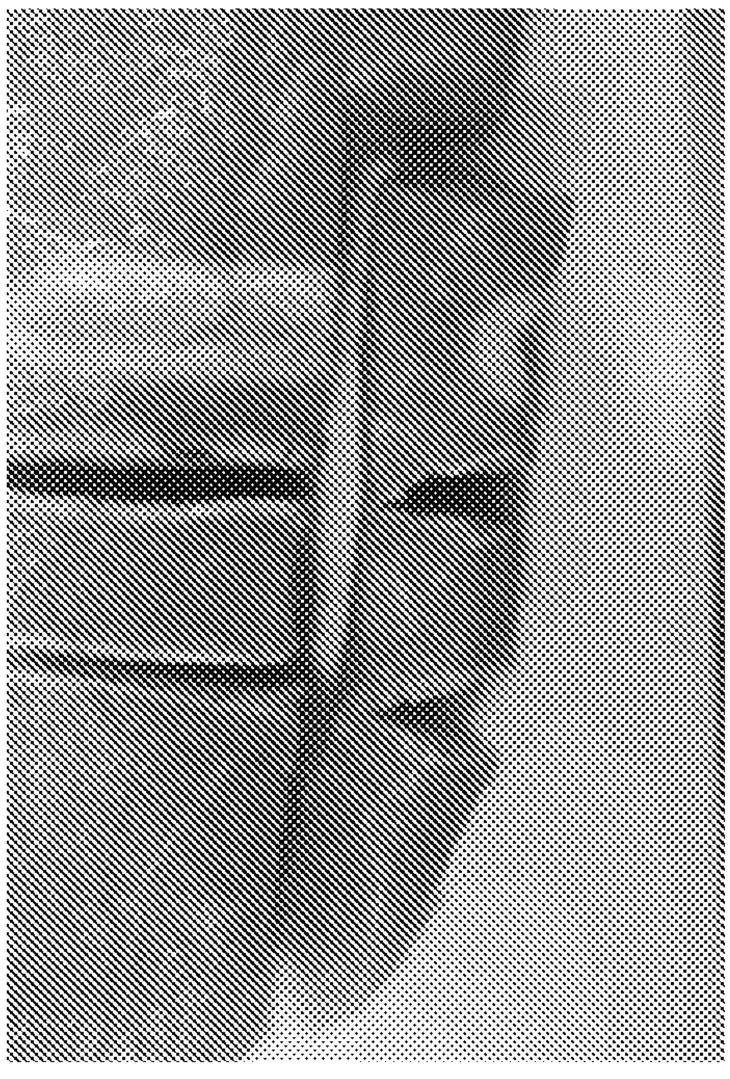


FIG. 12

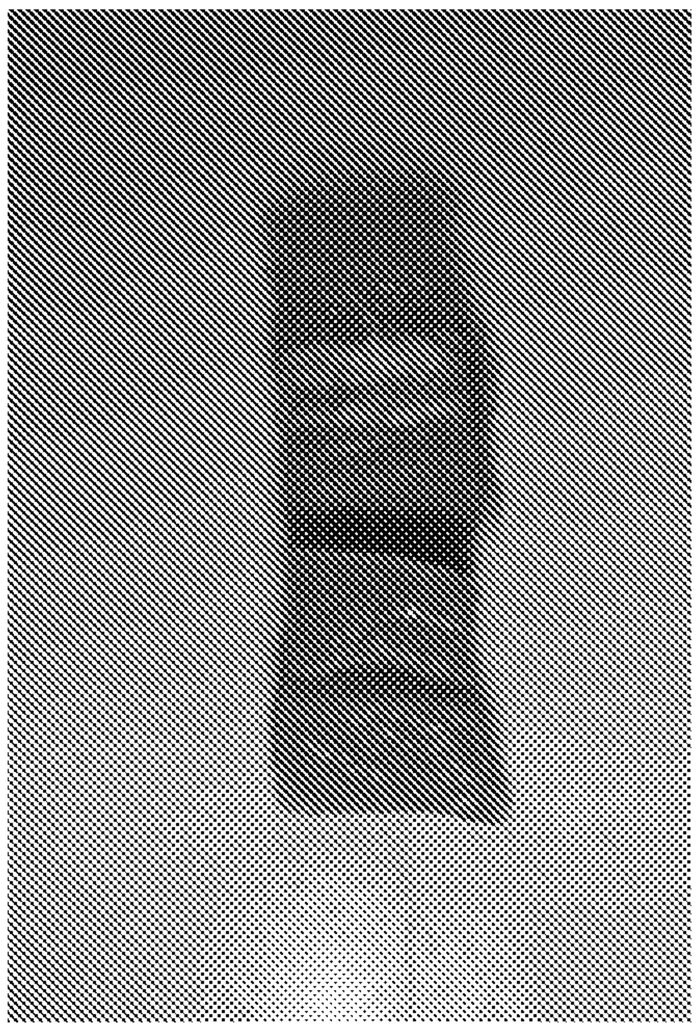


FIG. 9

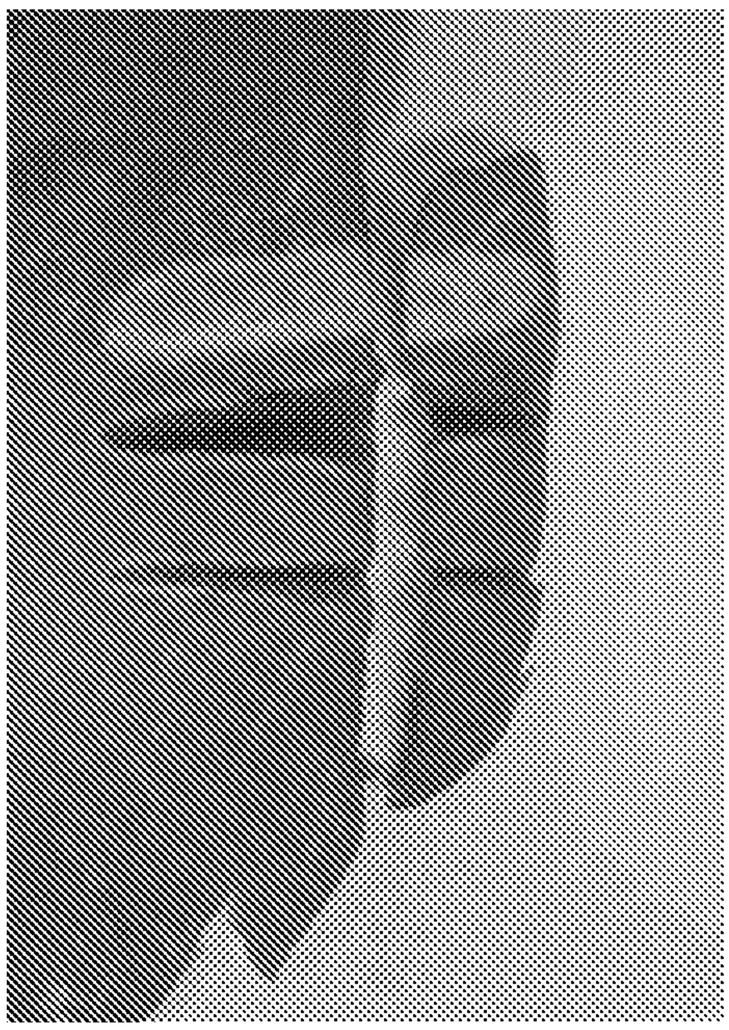


FIG. 11

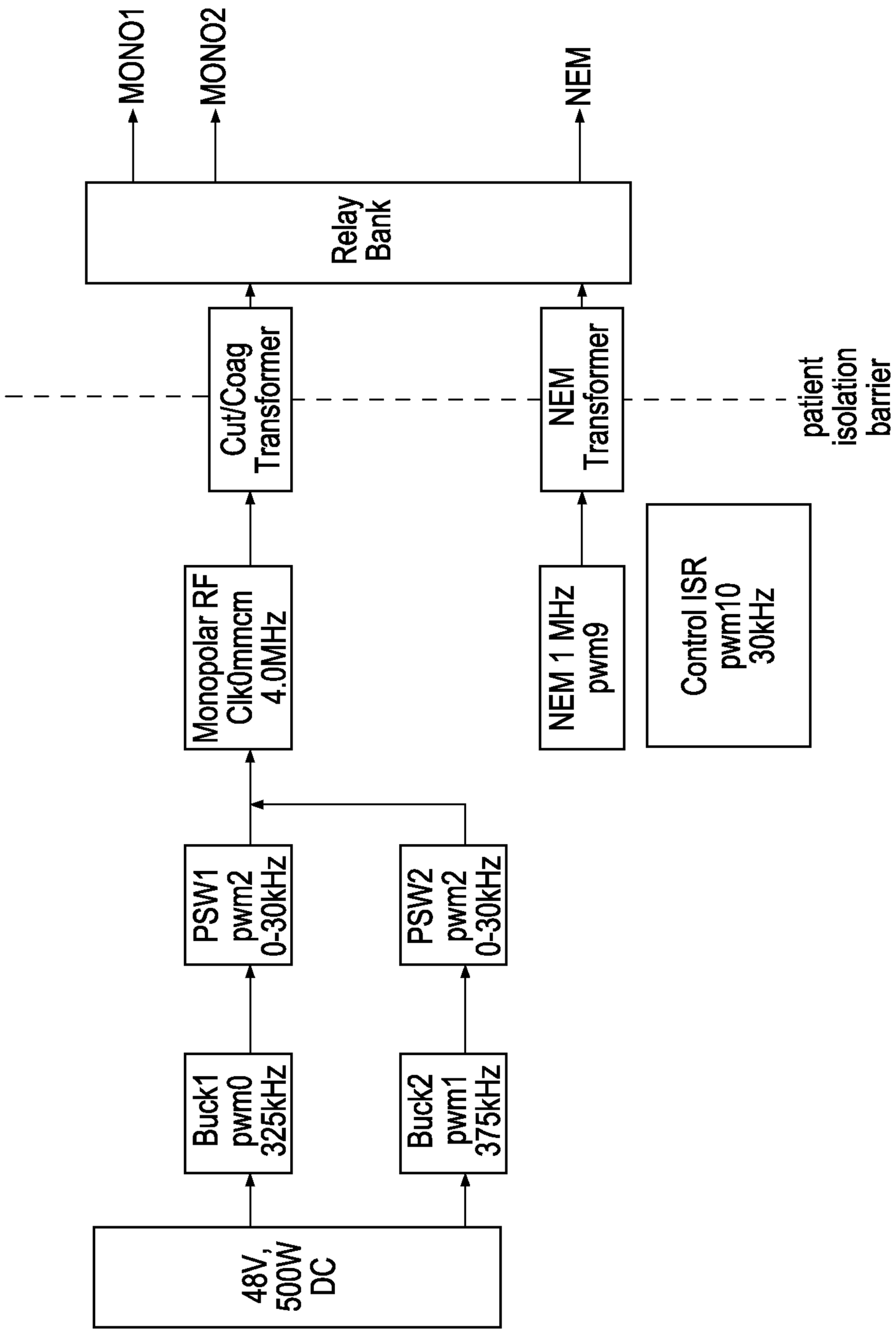

MONO1
MONO2
NEM
Relay Bank
Cut/Coag Transformer
NEM Transformer
patient isolation barrier
Monopolar RF Clk0mmcm 4.0MHz
NEM 1 MHz pwm9
Control ISR pwm10 30kHz
PSW1 pwm2 0-30kHz
PSW2 pwm2 0-30kHz
Buck1 pwm0 325kHz
Buck2 pwm1 375kHz
48V, 500W DC

FIG. 13

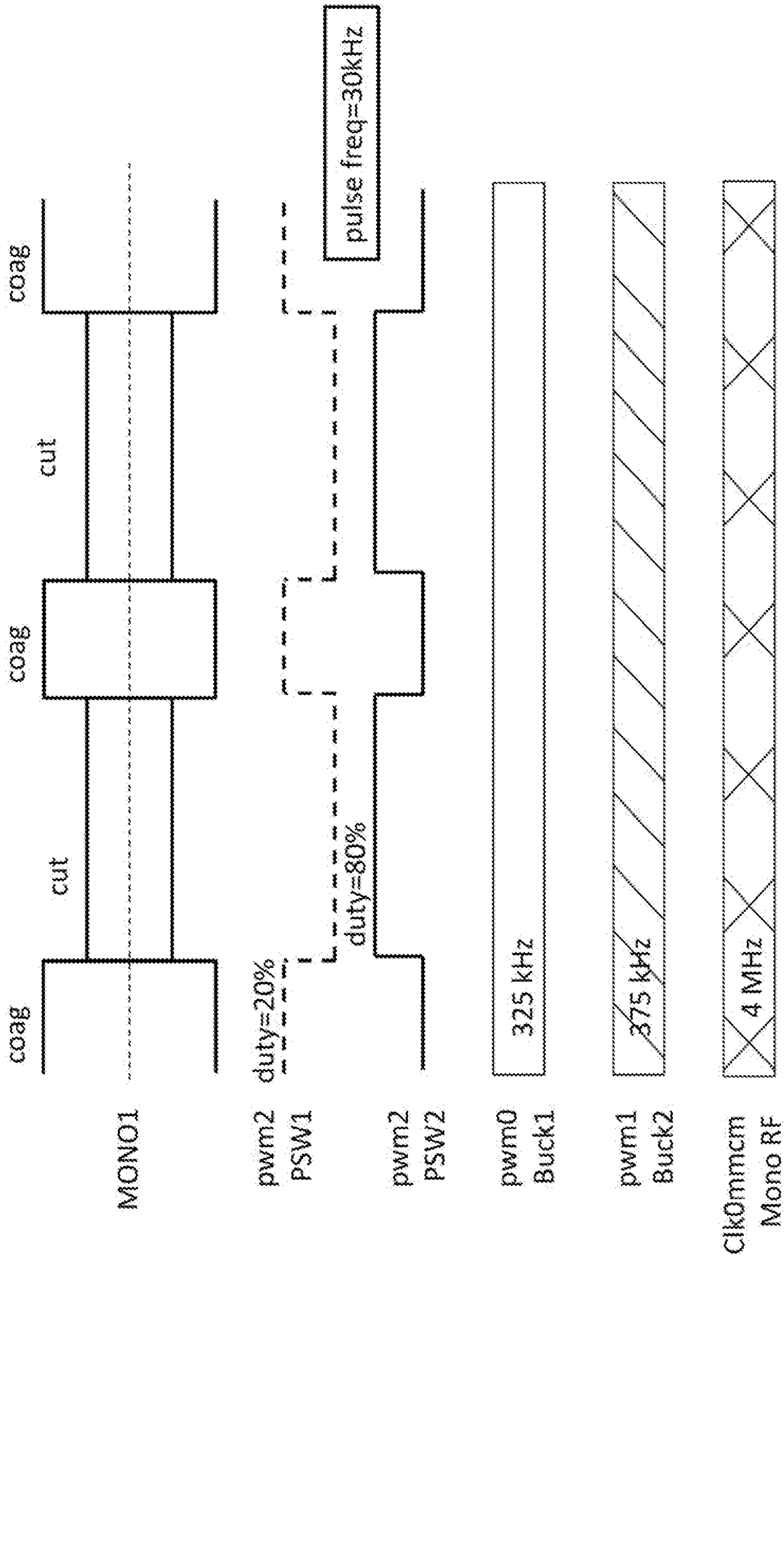

coag
cut
coag
coag
cut
duty=20%
duty=80%
pulse freq=30kHz
325 kHz
375 kHz
4 MHz
MONO1
pwm2
PSW1
pwm2
PSW2
pwm0
Buck1
pwm1
Buck2
Clk0mmcm
Mono RF

FIG. 14

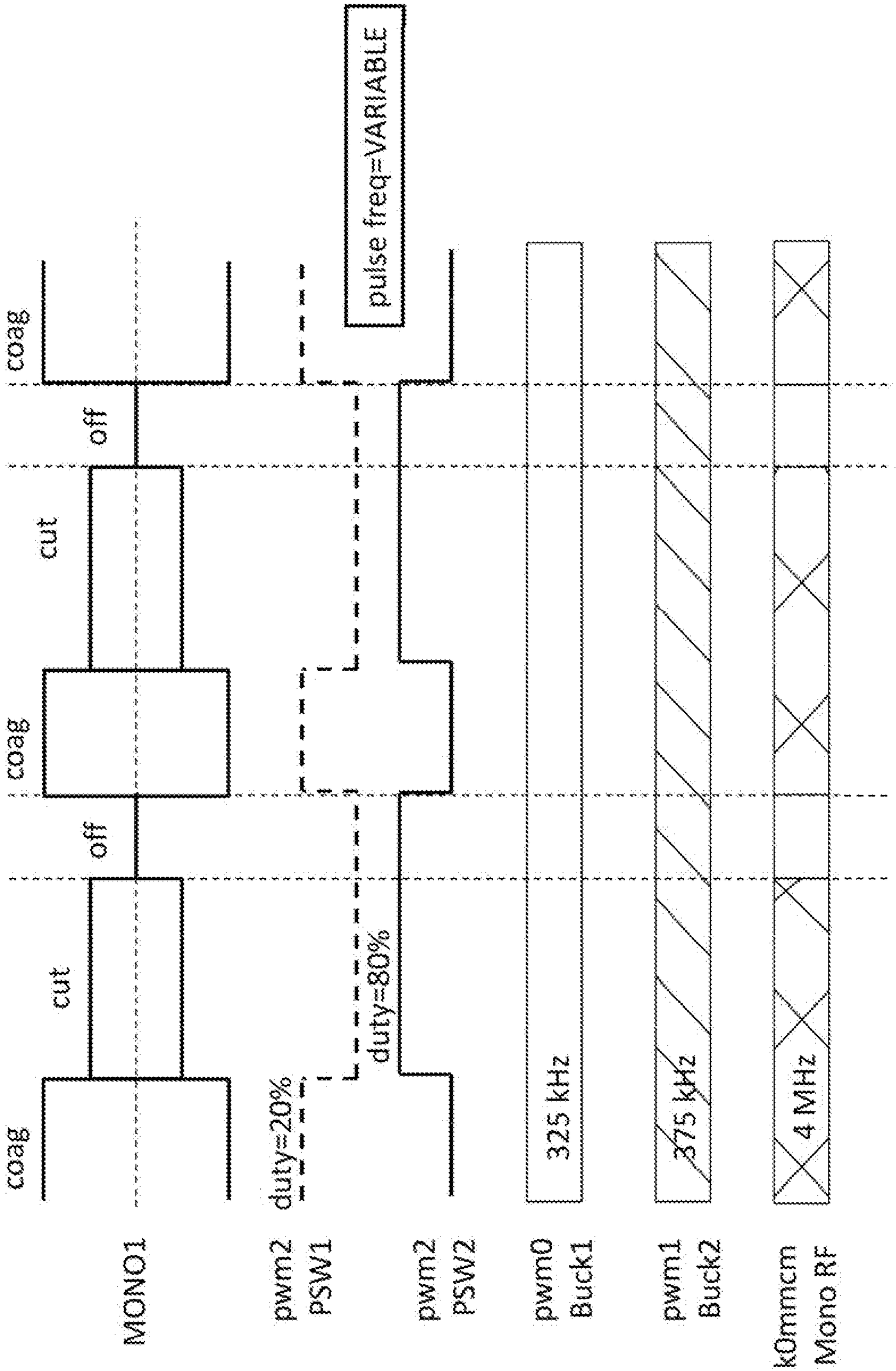

pulse freq=VARIABLE
coag
off
cut
coag
cut
off
coag
duty=20%
duty=80%
325 kHz
375 kHz
4 MHz
MONO1
pwm2
PSW1
pwm2
PSW2
pwm0
Buck1
pwm1
Buck2
ClkOmmcm
Mono RF

FIG. 15

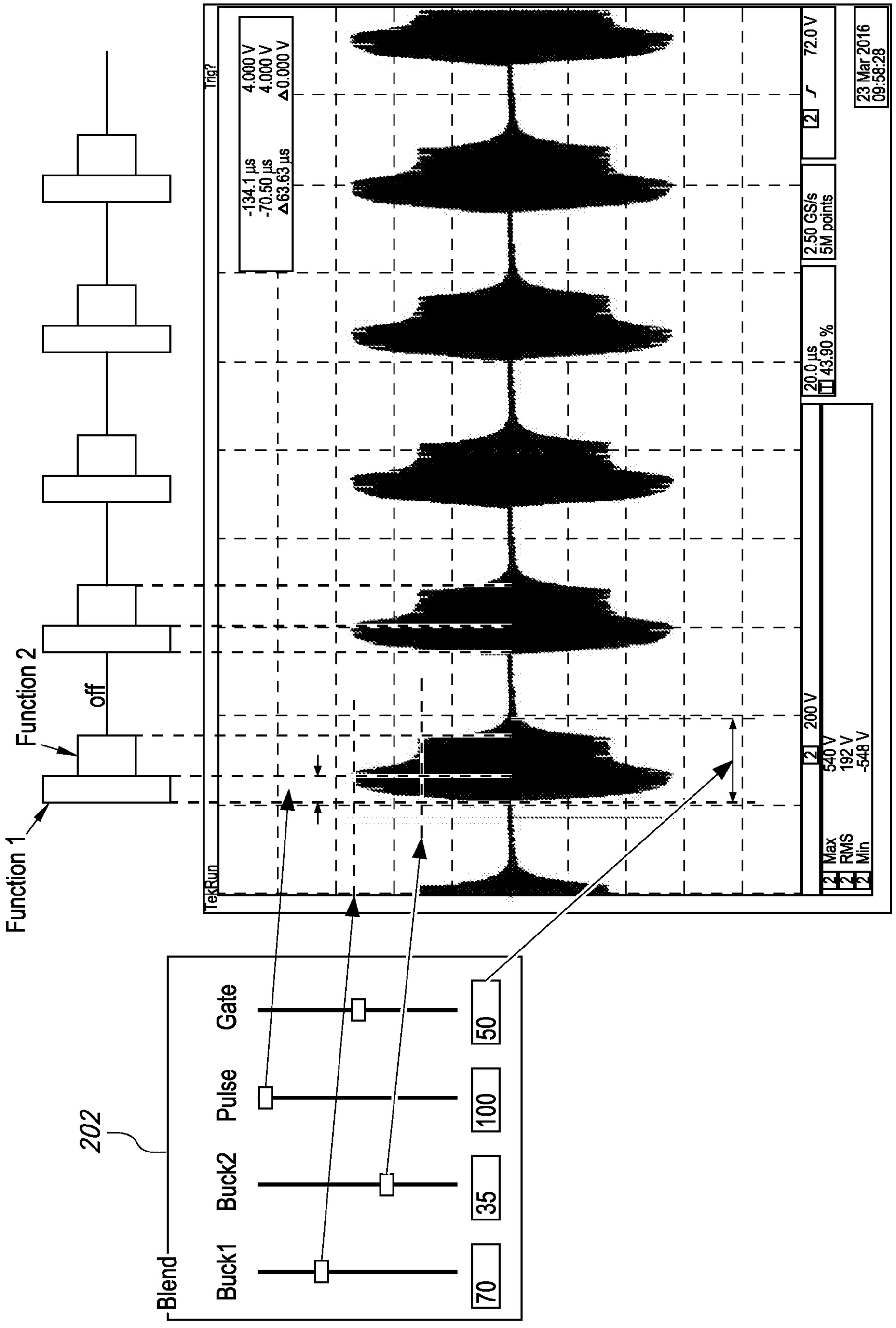

Function 2
off
Function 1
202
Blend
Buck1
Buck2
Pulse
Gate
70
35
100
50
Trig?
4.000 V
4.000 V
Δ0.000 V
-134.1 µs
-70.50 µs
Δ63.63 µs
TekRun
23 Mar 2016
09:58:28
2 72.0 V
2.50 GS/s
5M points
20.0 µs
43.90 %
200 V
Max 540 V
RMS 192 V
Min -548 V

FIG. 16

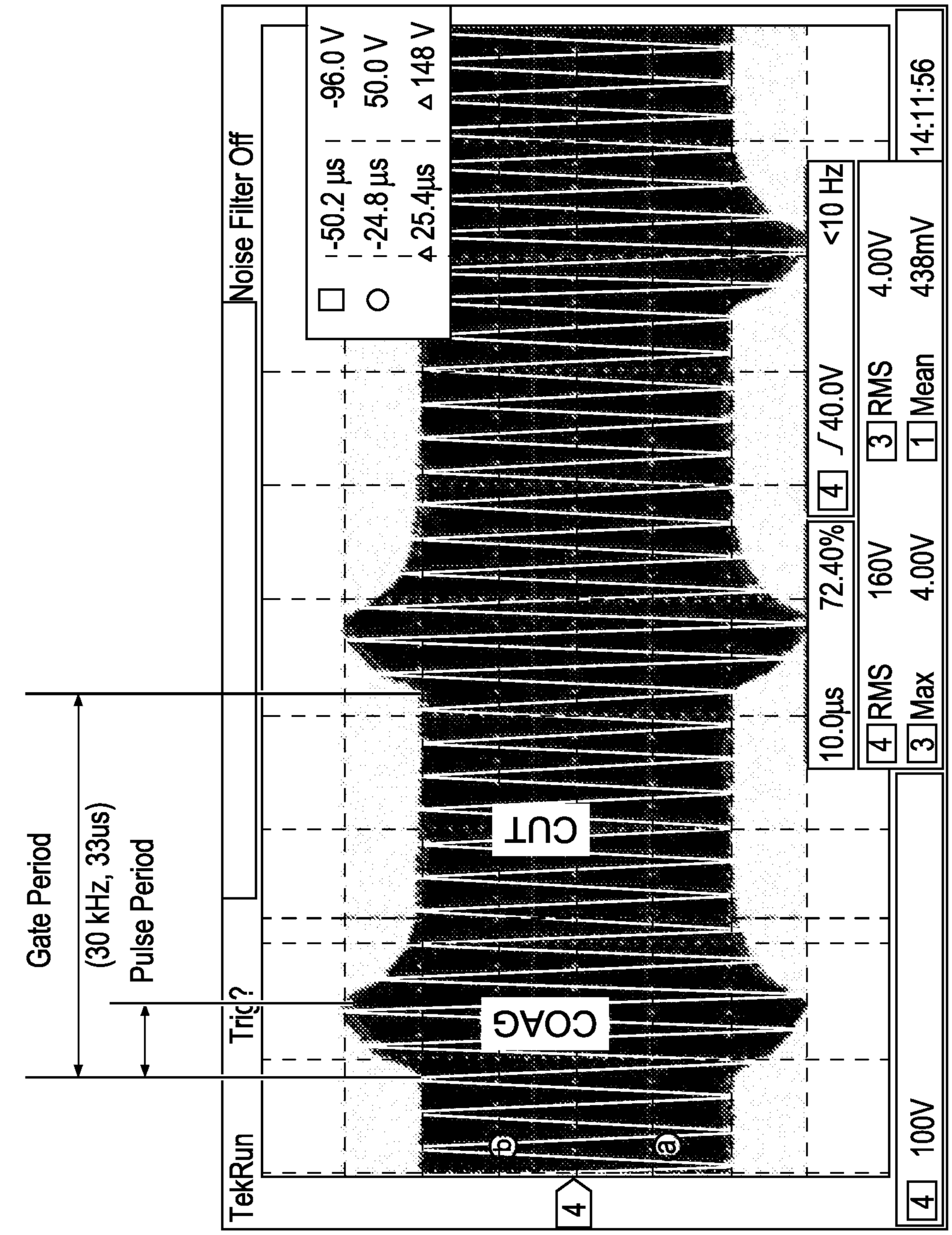

Noise Filter Off
-50.2 µs -96.0 V
-24.8 µs 50.0 V
Δ 25.4µs Δ 148 V
<10 Hz
∫ 40.0V
3 RMS 4.00V
1 Mean 438mV
14:11:56
72.40%
10.0µs
4 RMS 160V
3 Max 4.00V
100V
Gate Period
(30 kHz, 33us)
Pulse Period
CUT
COAG
Trig?
TekRun
a
b
4
4

FIG. 17

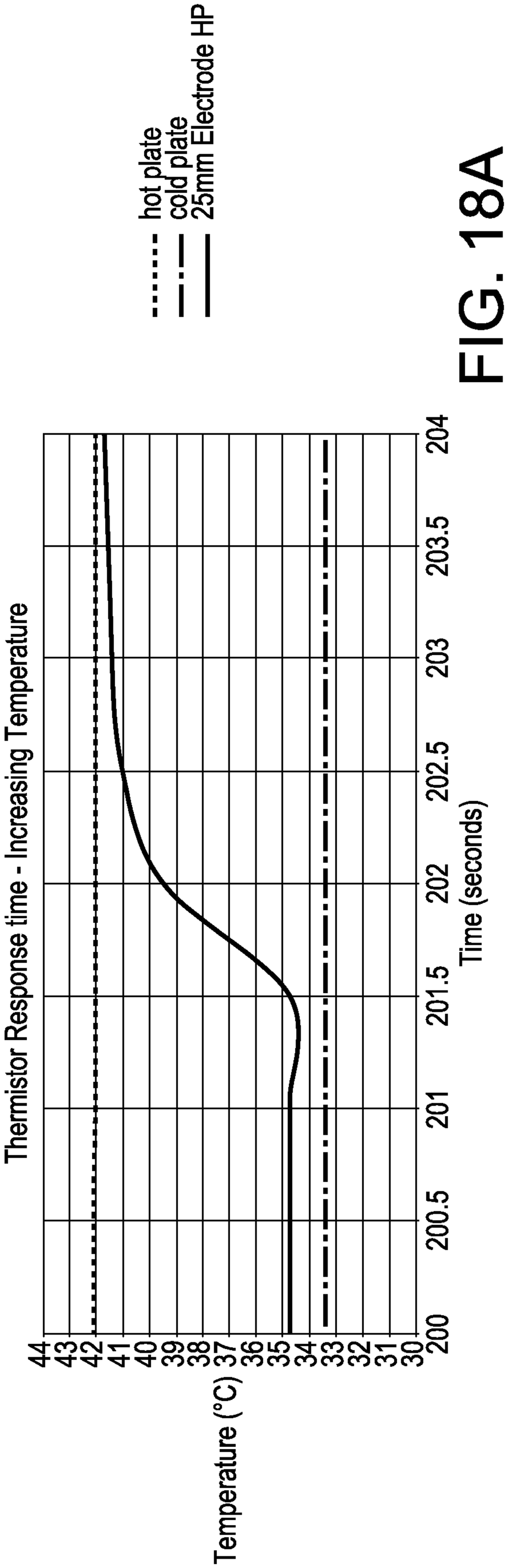

hot plate
cold plate
25mm Electrode HP
Thermistor Response time - Increasing Temperature
Time (seconds)
Temperature (°C)
200
200.5
201
201.5
202
202.5
203
203.5
204
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

FIG. 8A

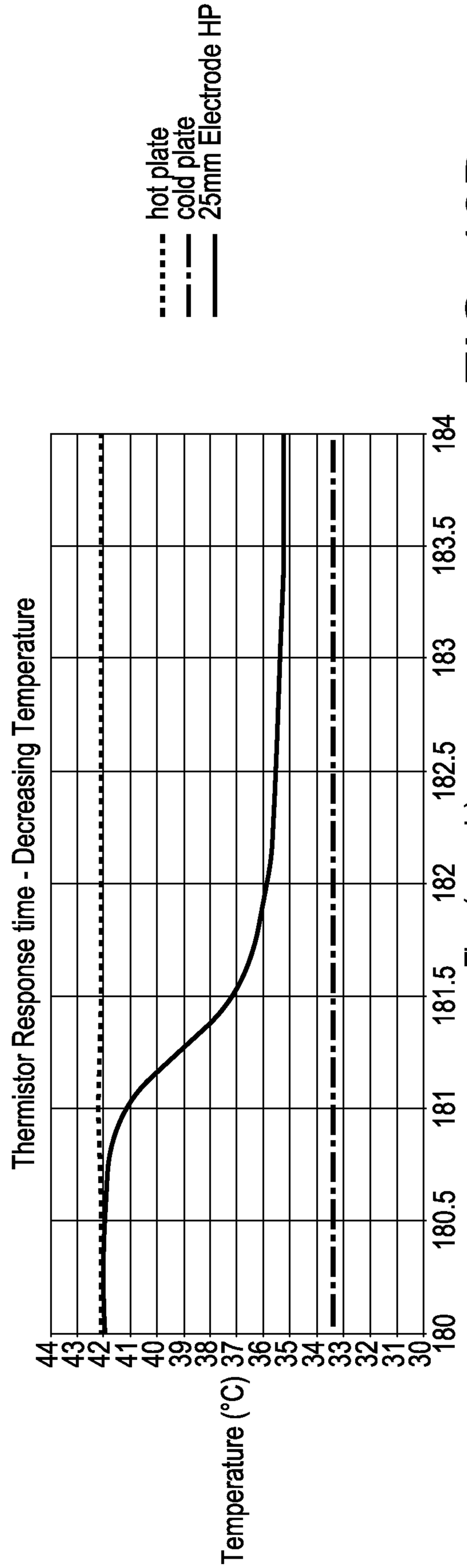

hot plate
cold plate
25mm Electrode HP
Thermistor Response time - Decreasing Temperature
Time (seconds)
Temperature (°C)
180
180.5
181
181.5
182
182.5
183
183.5
184
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

FIG. 8B

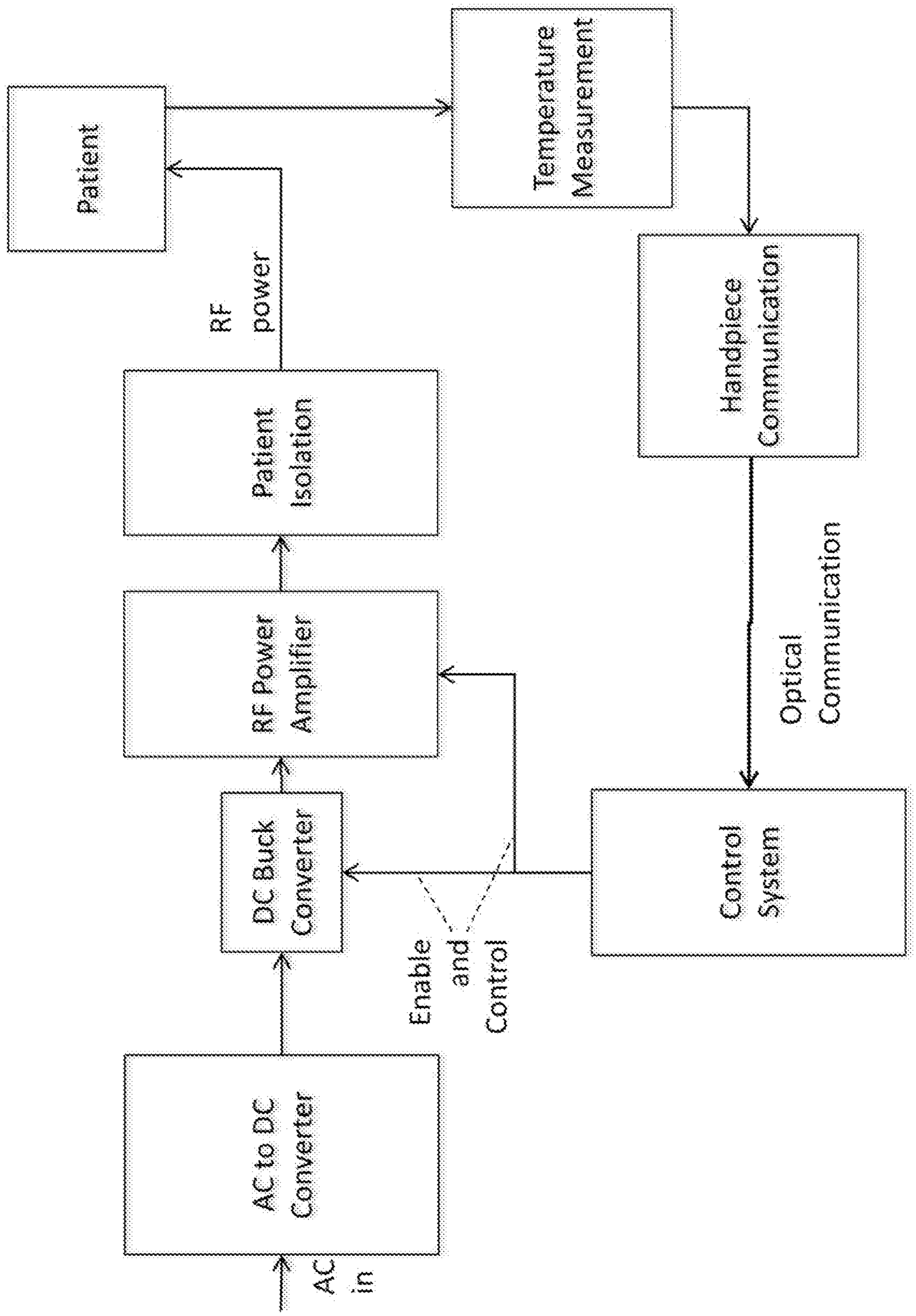

Patient
Temperature Measurement
RF power
Patient Isolation
Handpiece Communication
RF Power Amplifier
Optical Communication
DC Buck Converter
Control System
Enable and Control
AC to DC Converter
AC in

FIG. 19

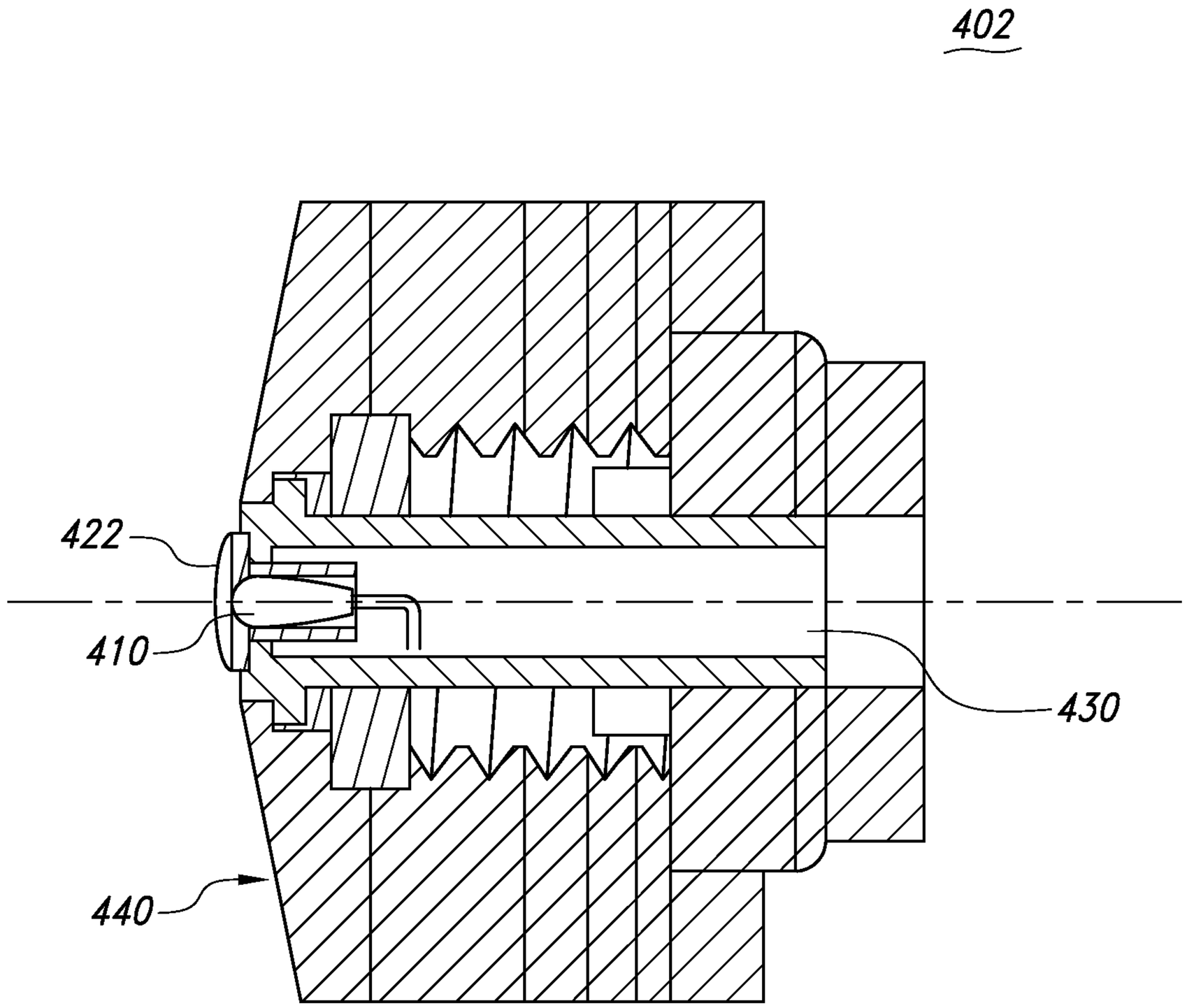


FIG. 20

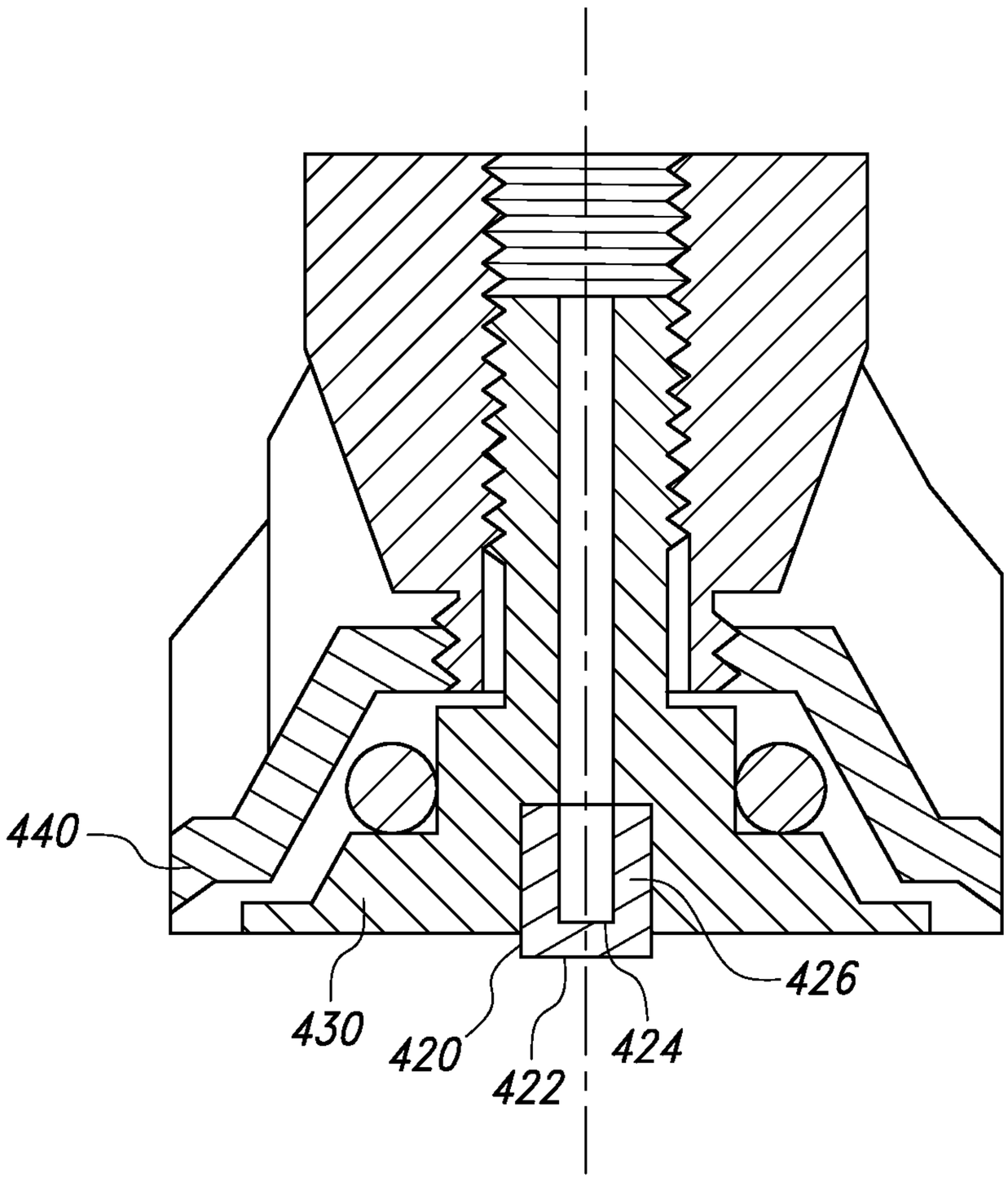


FIG. 21

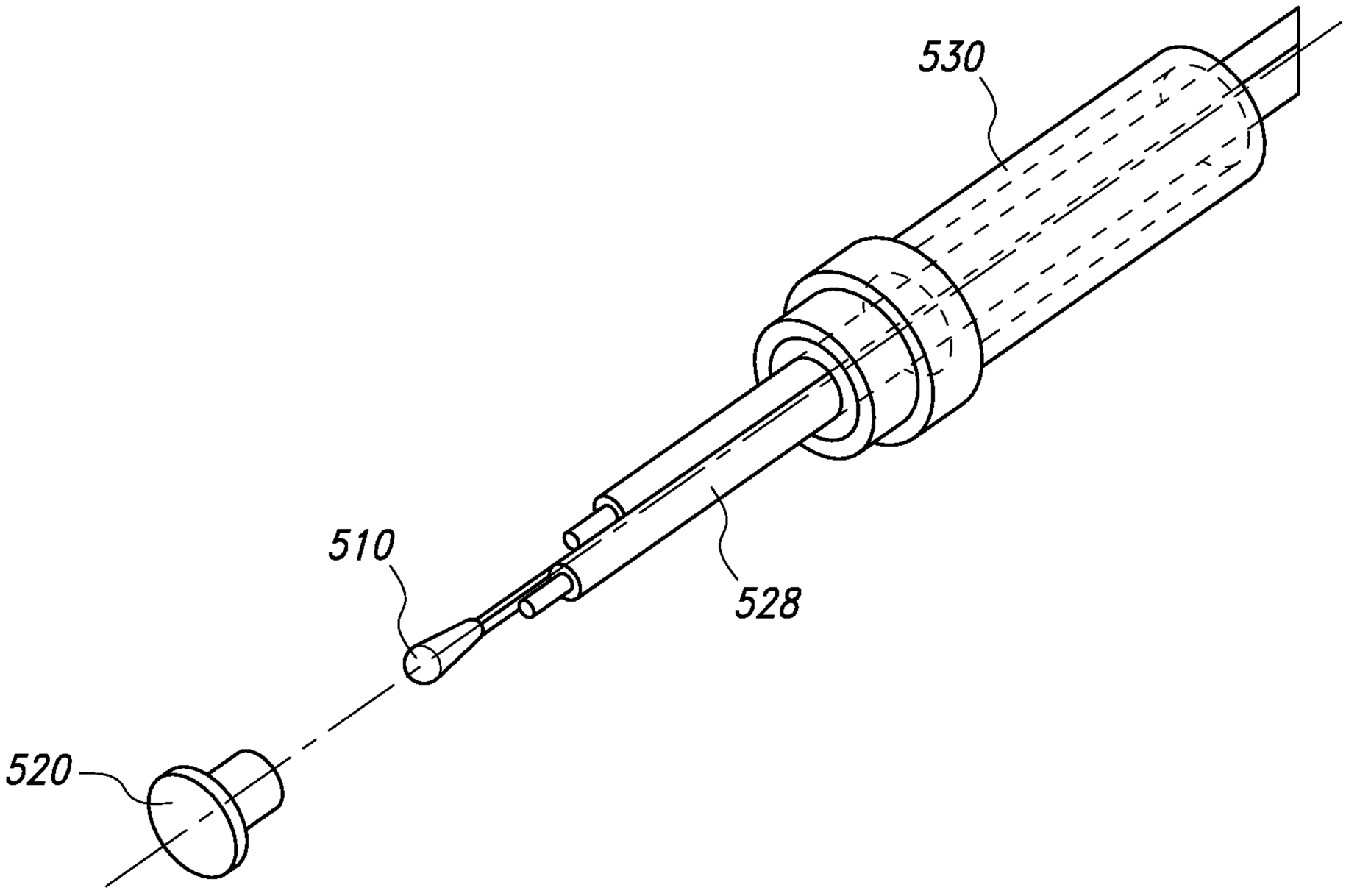


FIG. 22

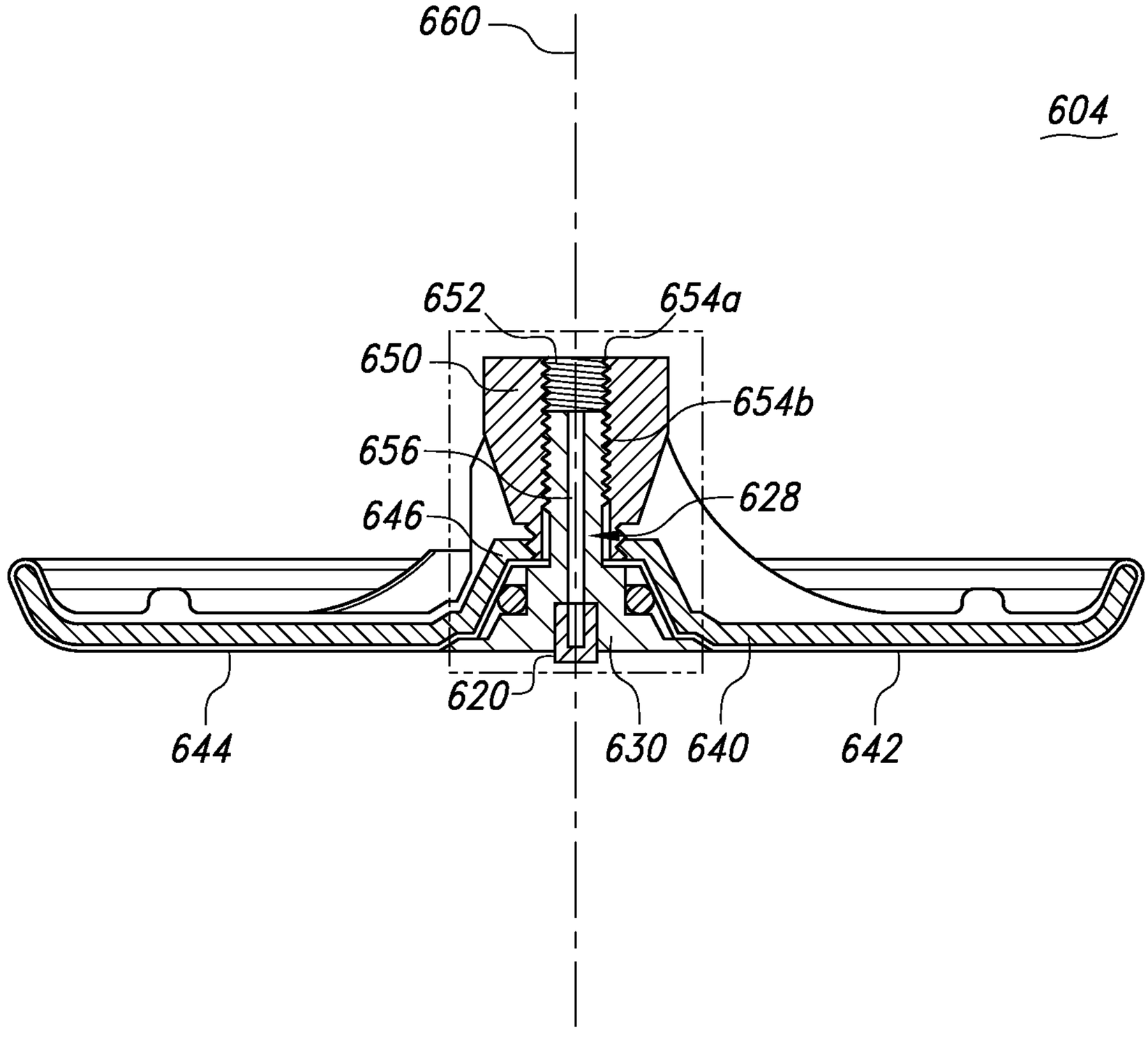


FIG. 23

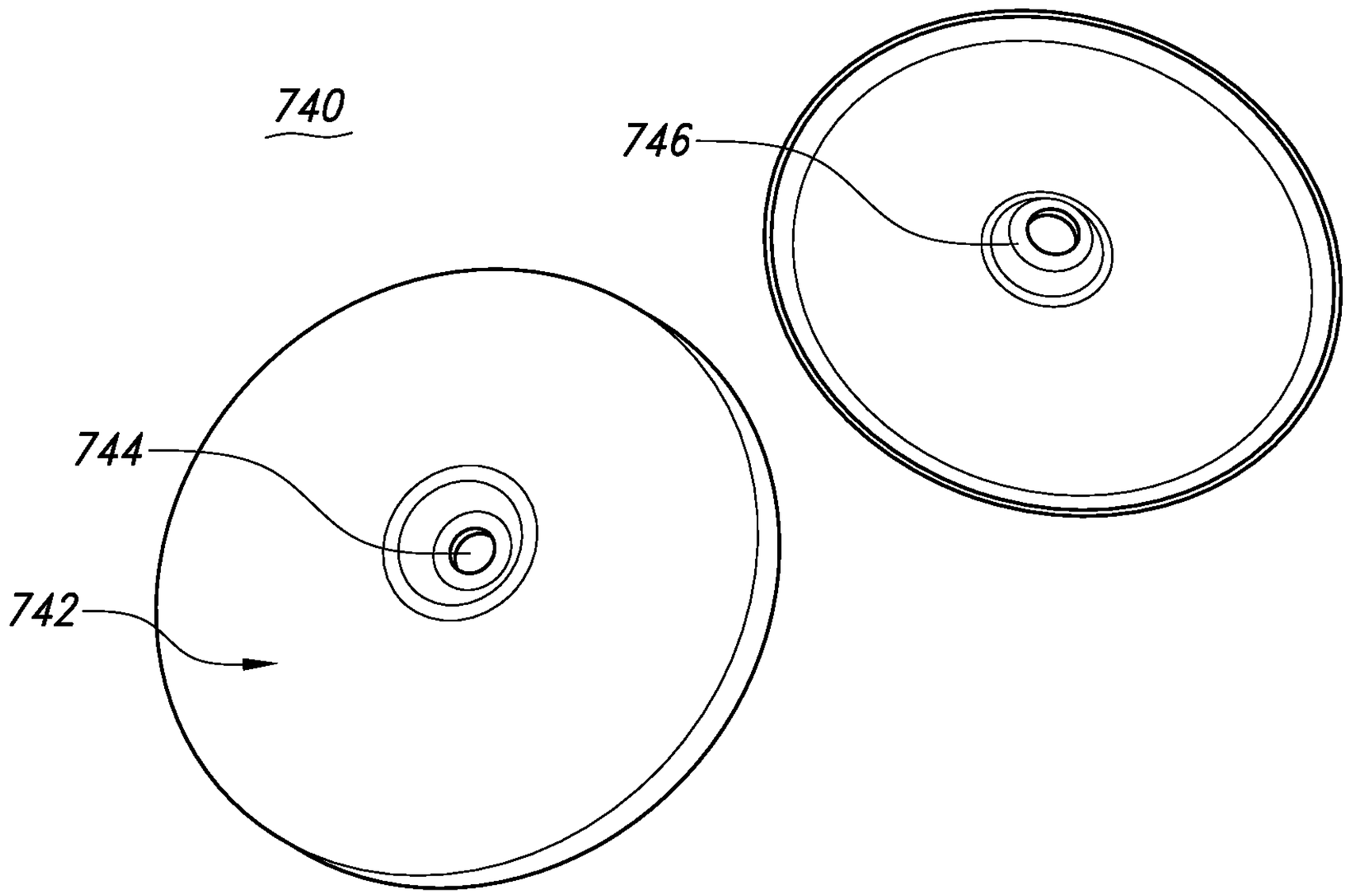


FIG. 24

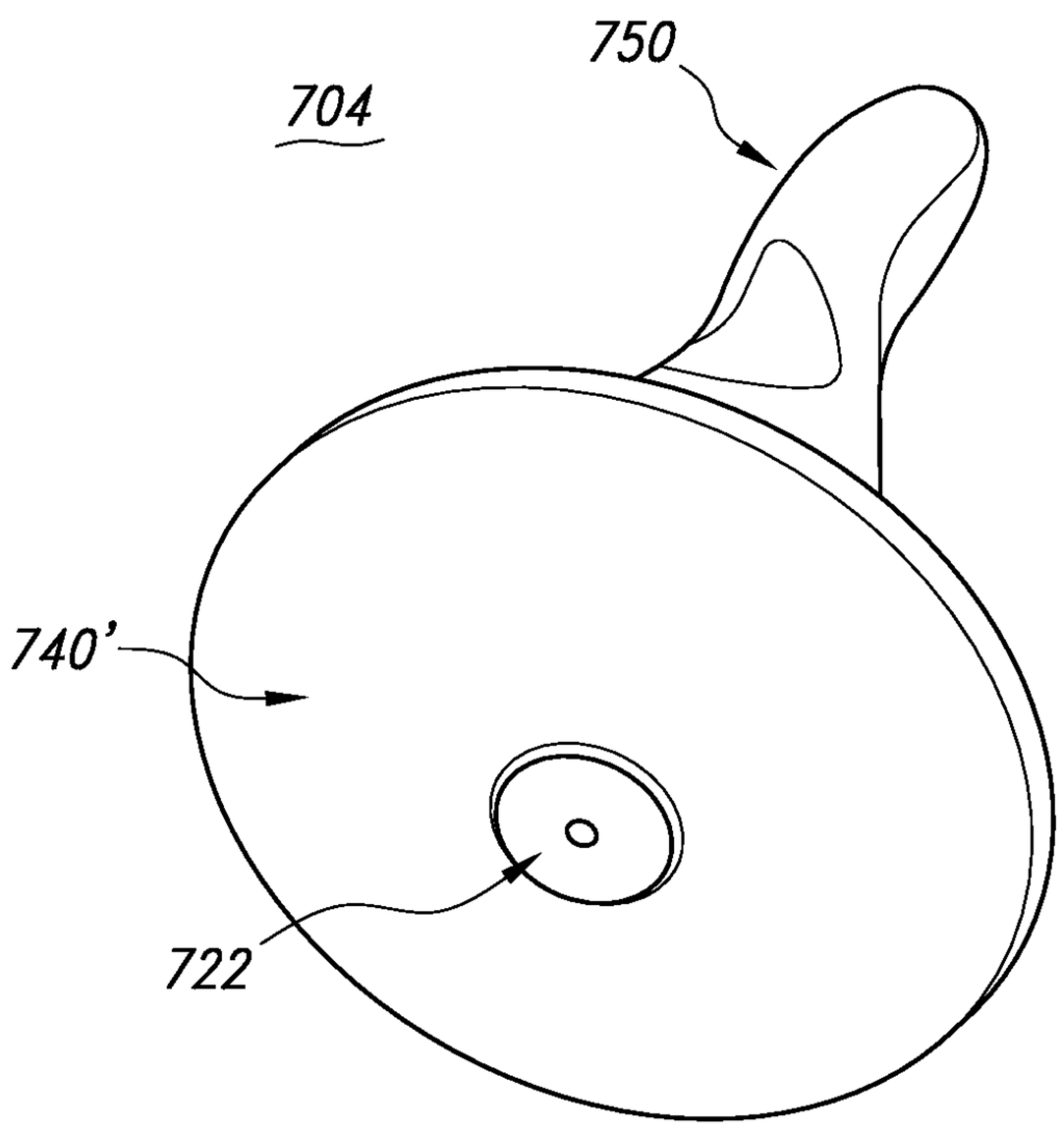


FIG. 25

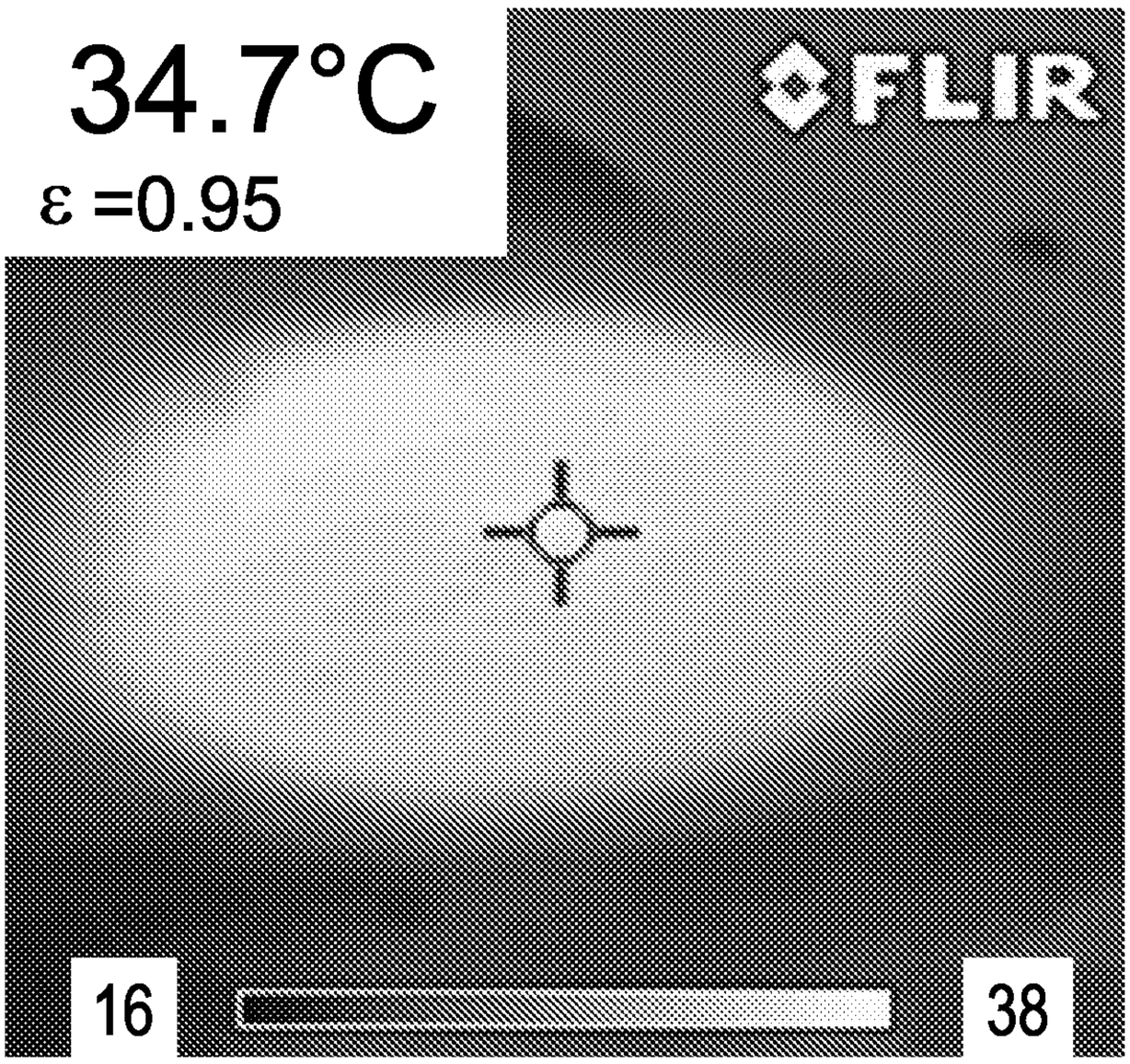

34.7°C
ε =0.95
FLIR
16
38

FIG. 26

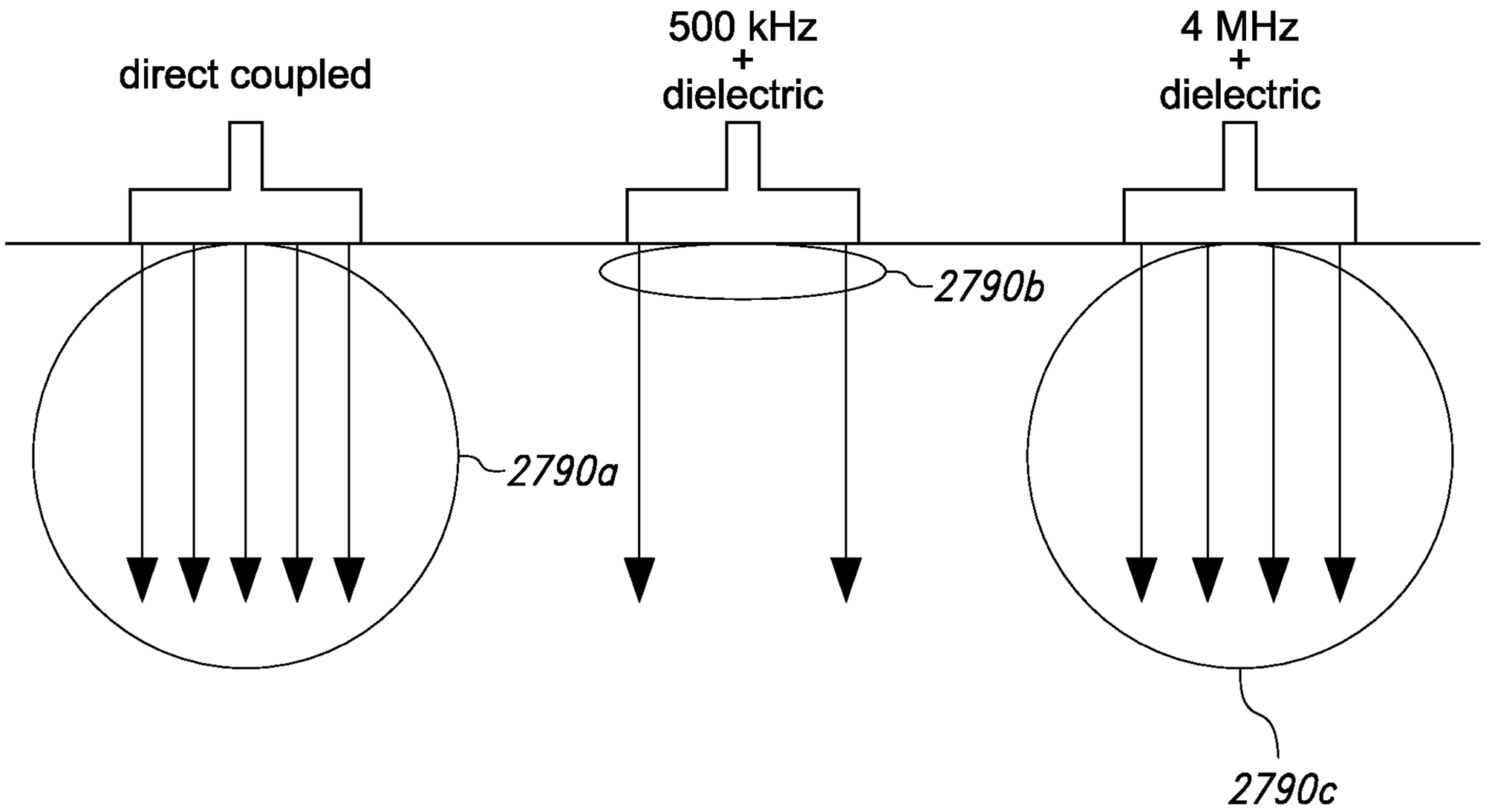

direct coupled
500 kHz
+
dielectric
4 MHz
+
dielectric
2790a
2790b
2790c

FIG. 27

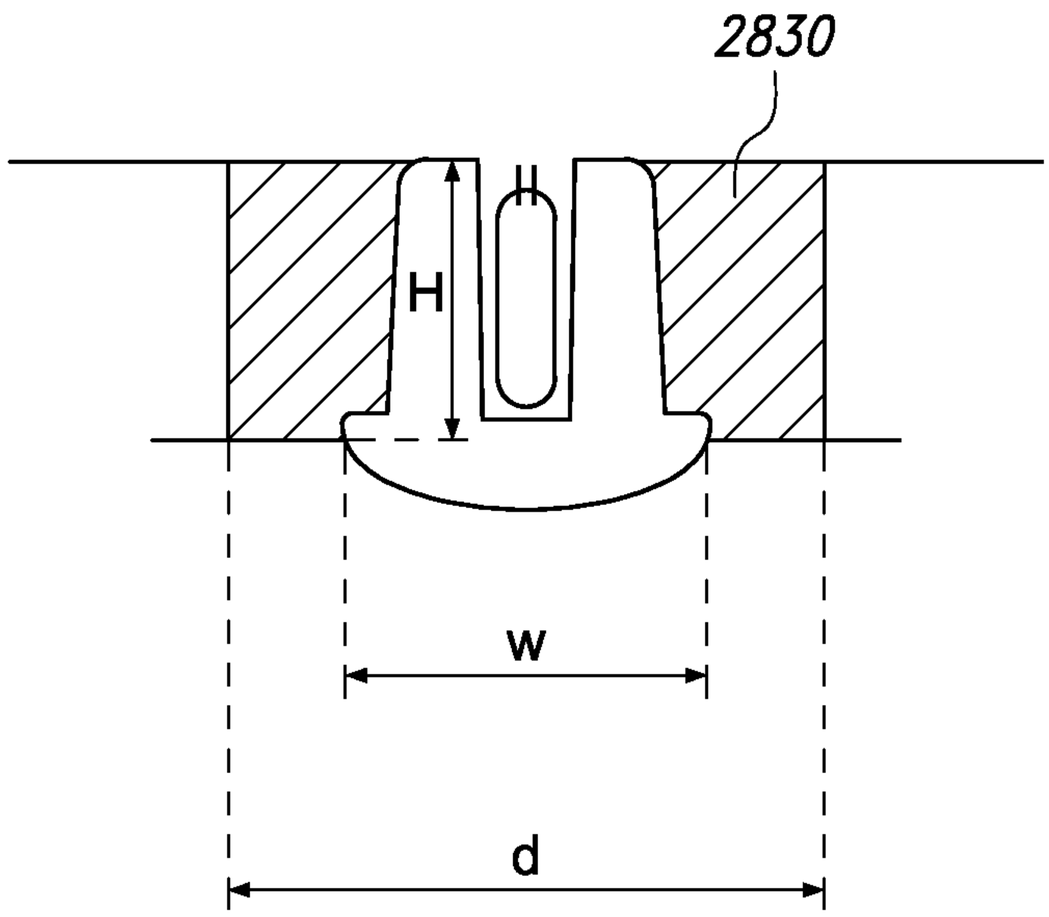


FIG. 28A

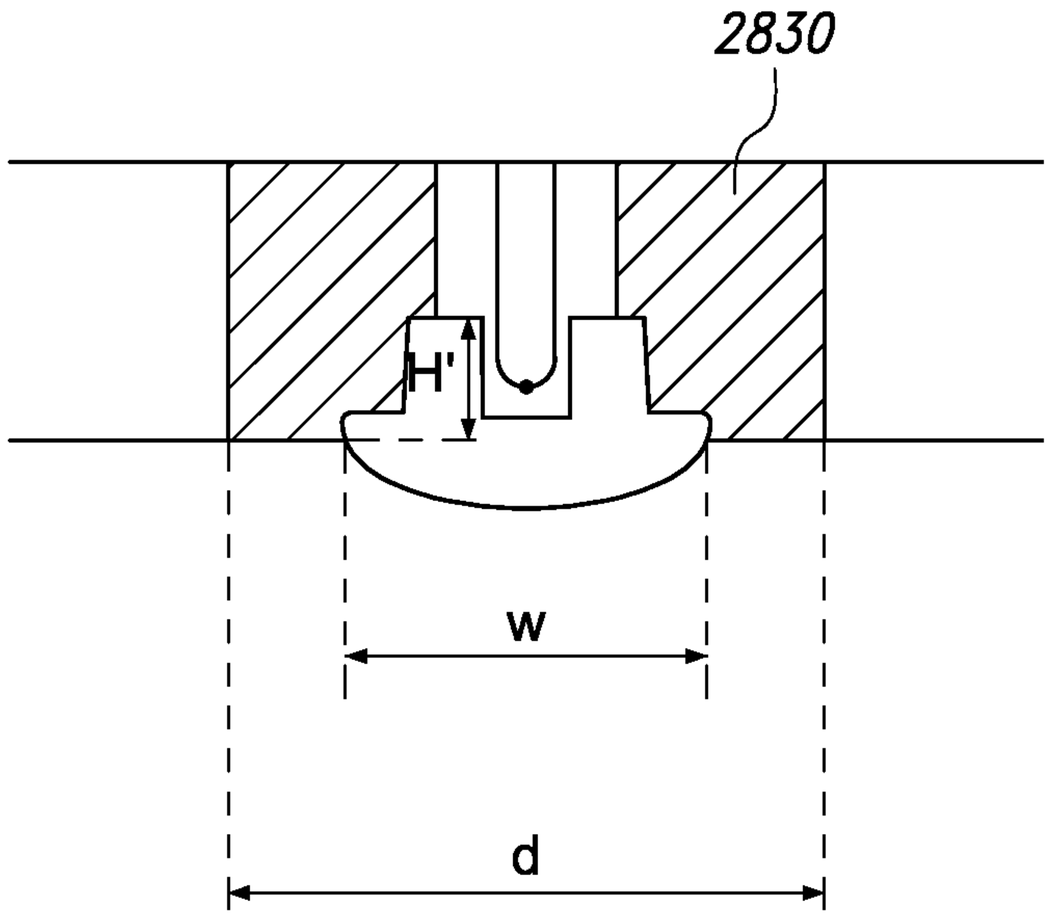


FIG. 28B

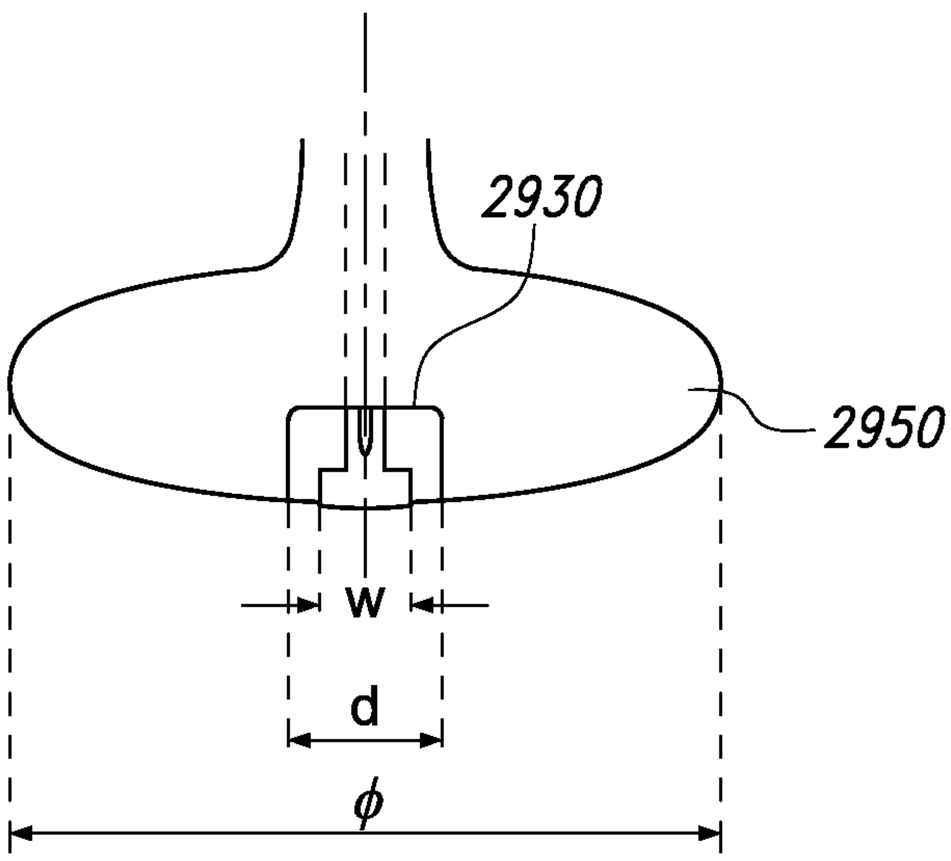


FIG. 29

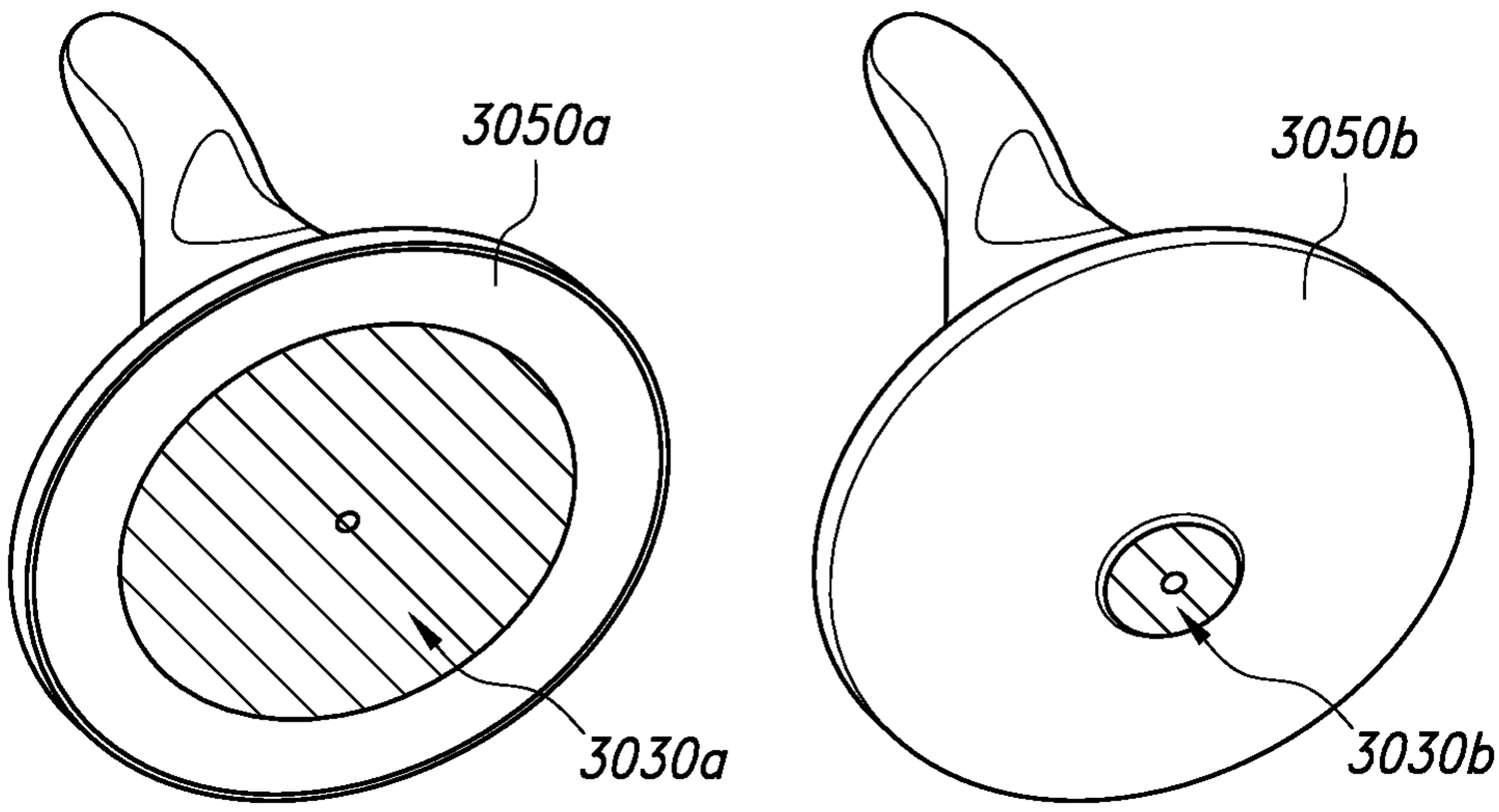


FIG. 30

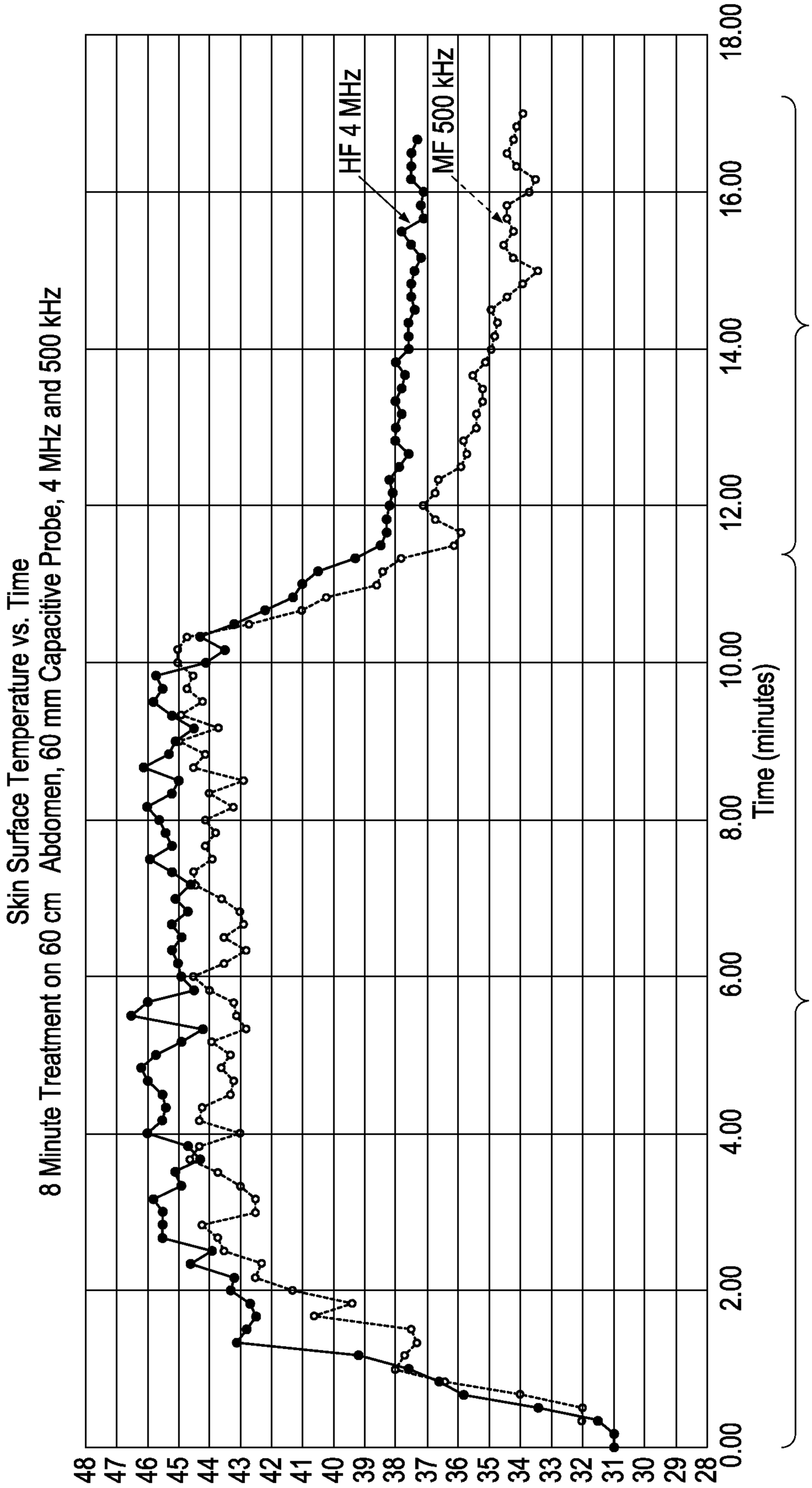

Skin Surface Temperature vs. Time
8 Minute Treatment on 60 cm Abdomen, 60 mm Capacitive Probe, 4 MHz and 500 kHz
HF 4 MHz
MF 500 kHz
RF energy is on
RF energy is off
Time (minutes)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48

FIG. 31

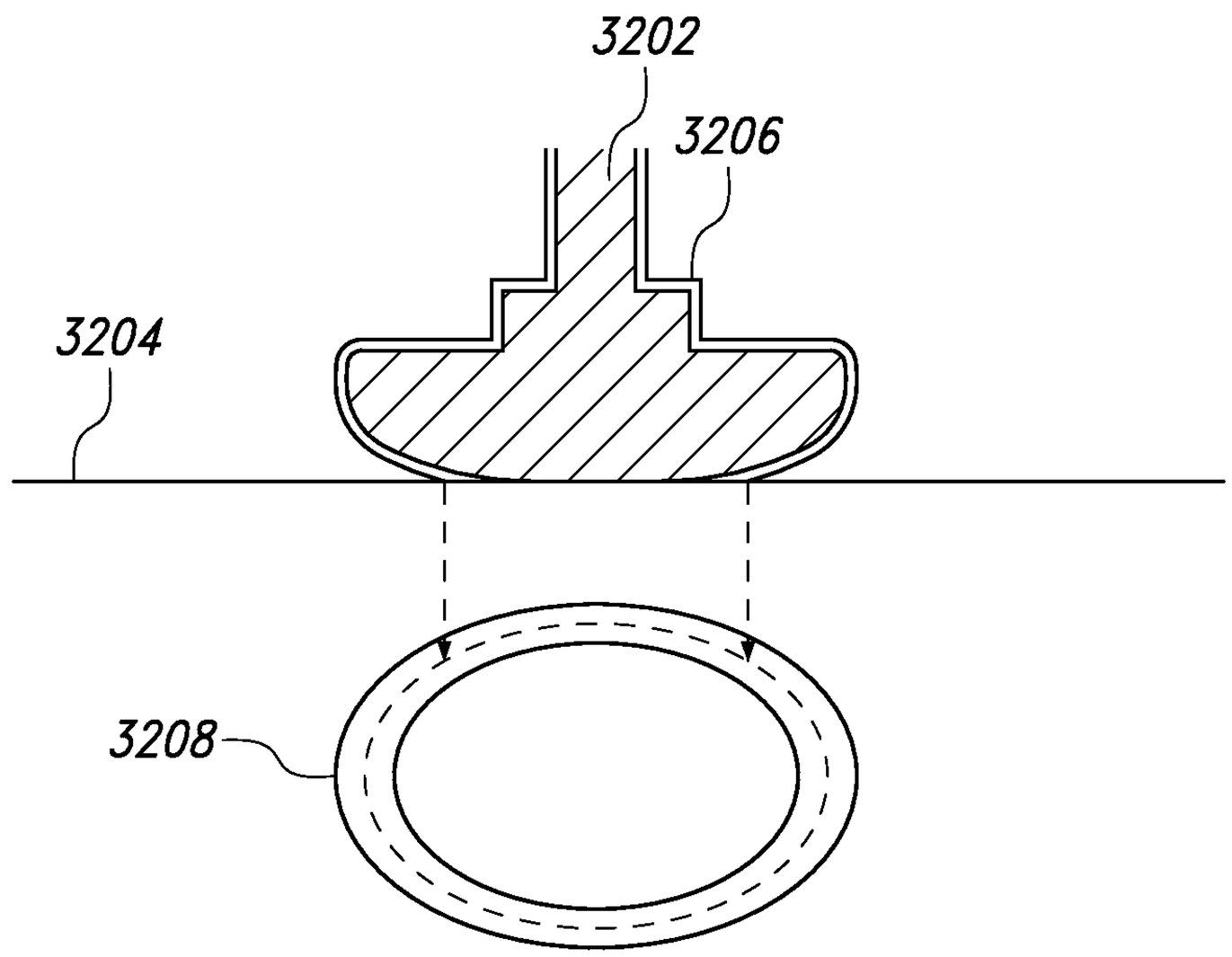


FIG. 32A

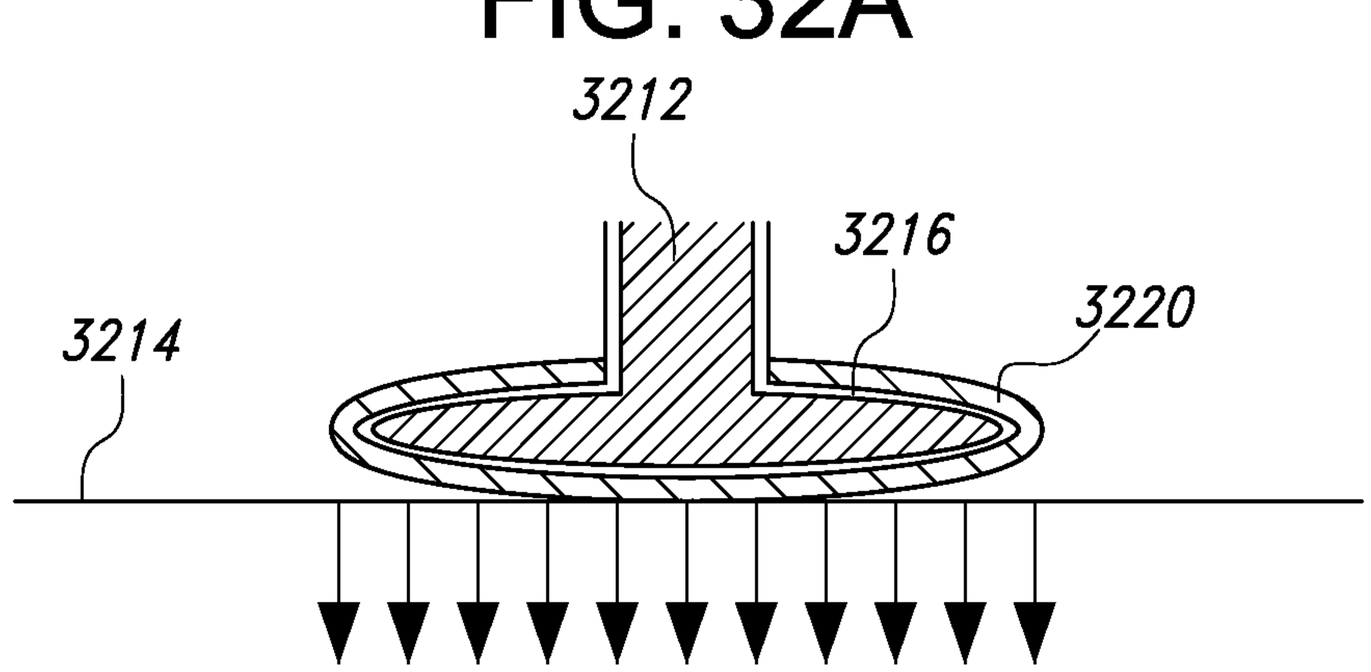


FIG. 32B

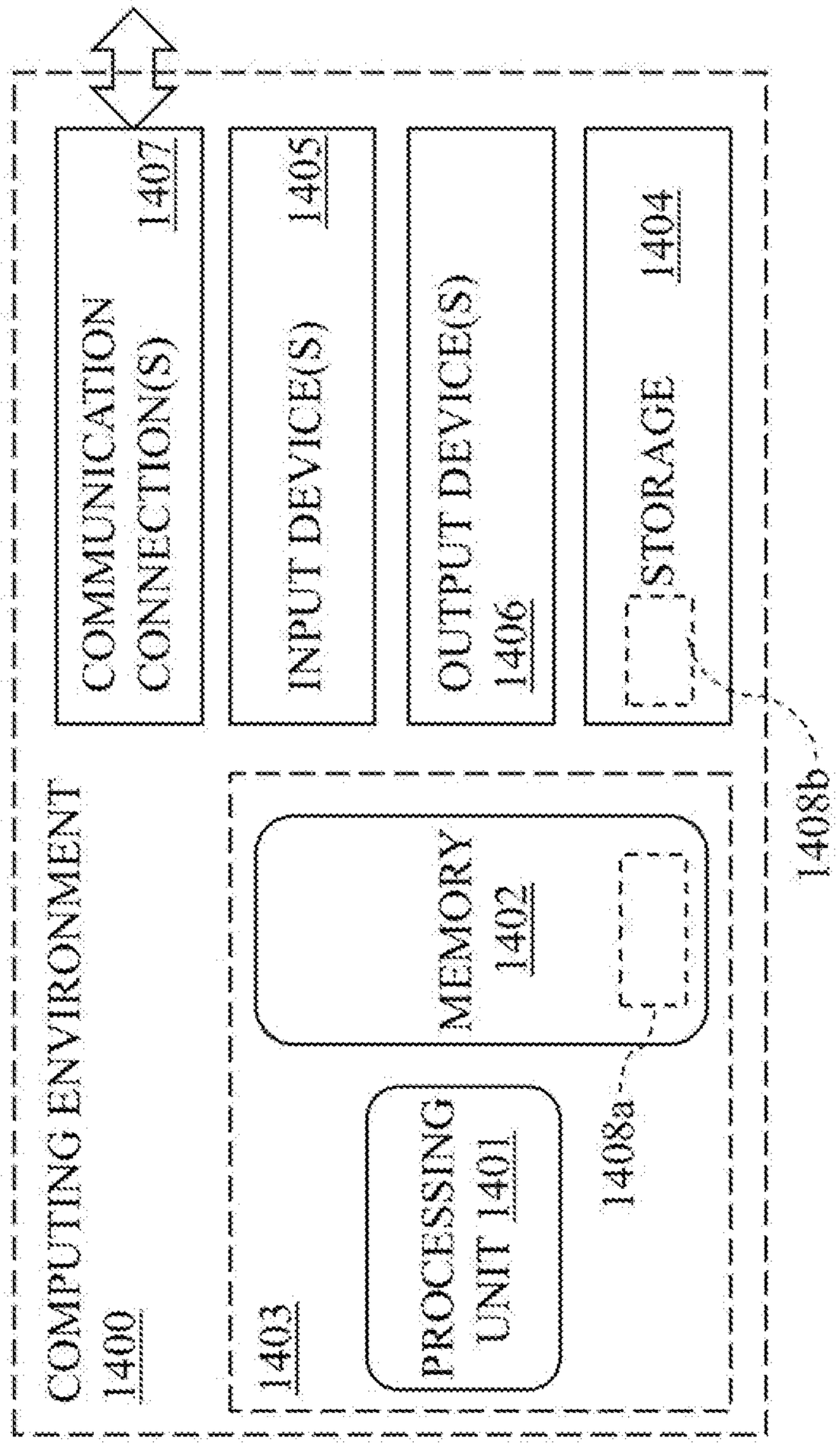
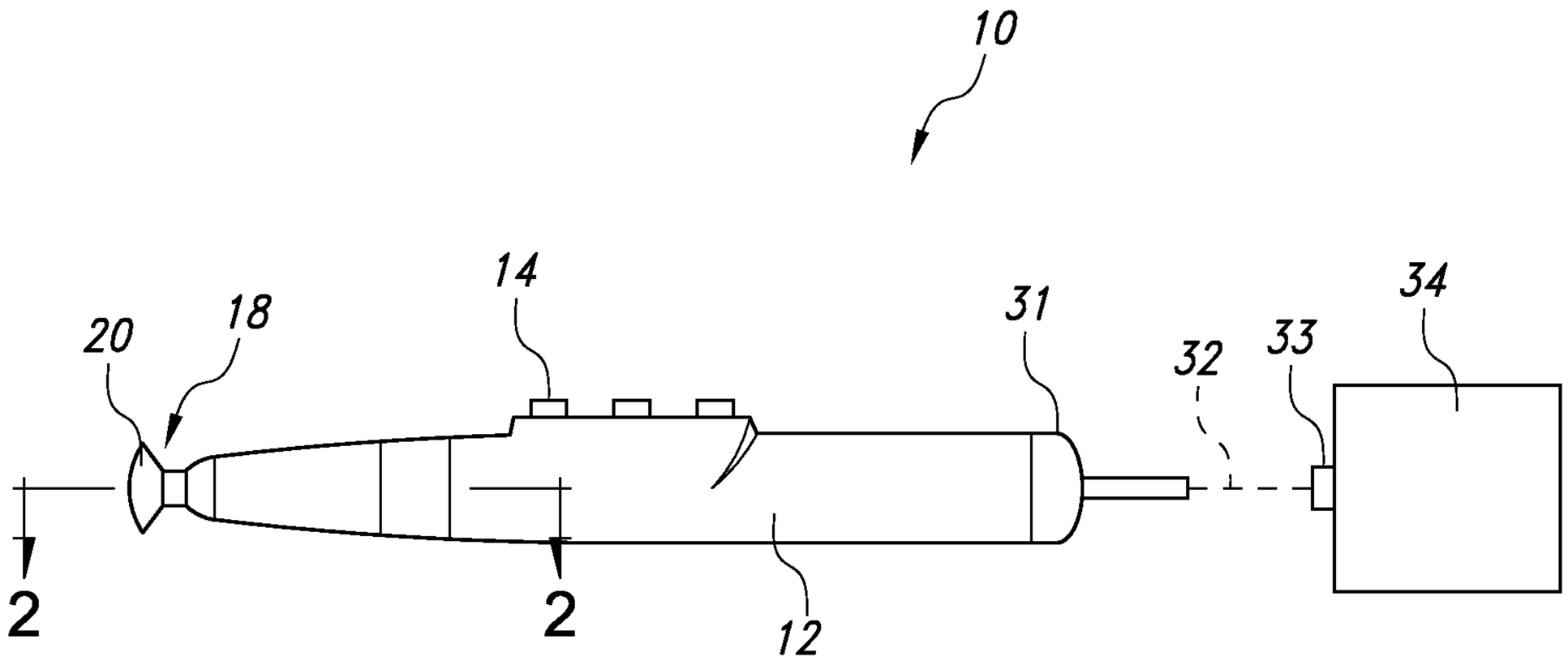

COMMUNICATION CONNECTION(S) 1407
INPUT DEVICE(S) 1405
OUTPUT DEVICE(S) 1406
STORAGE 1404
COMPUTING ENVIRONMENT 1400
1403
PROCESSING UNIT 1401
MEMORY 1402
1408a
1408b
1408

FIG. 33



(PRIOR ART)

FIG. 34