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(54) **Antenna filter, sensor system and method for measuring a fluid.**

(57) The invention relates to an antenna filter, sensor system with such antenna filter, and a method for measuring a fluid. The antenna device comprises a first conductor and a second conductor placed at a distance from the first conductor, wherein the distance between the first and second conductors defines a volume that in use holds the fluid to achieve a fluid containing transmission line.

ANTENNA FILTER, SENSOR SYSTEM AND METHOD FOR MEASURING A FLUID

The present invention relates to an antenna filter for measuring a fluid. More specifically, the filter is used for measuring properties of a fluid, like drinking water.

In present practice, for measuring a fluid, samples are often taken and analyzed in laboratories. Such analysis is performed off-line. This results in a time delay before measurement information is available. Furthermore, this practice is relatively labour intensive.

Existing prior art sensors to measure properties of a solution are based on either capacitive or microwave measurements. These techniques suffer from relatively large parasitic capacities thereby limiting the sensitivity of the measurement and/or require a relatively complex measurement set up involving relatively high investment costs.

The object of the present invention is to improve the measuring of a fluid to enable an effective and efficient measurement thereof.

This object is achieved with the antenna filter for measuring a fluid according to the invention, the antenna filter comprising:

- a first conductor; and
- a second conductor placed at a distance from the first conductor, wherein the distance between the first and second conductors defines a volume that in use holds the fluid to achieve a fluid containing transmission line.

By providing a first and second conductor at a distance from each other the volume between the at least two conductors can be filled with a fluid. When in use, the fluid defines a fluid containing transmission line, preferably transmitting a radio frequency signal. The filter comprises a fluid, like water, as dielectricum between the conductors. The characteristics of such filter depend, amongst other things, on the dielectric constant of the fluid. This constant is influenced by the presence of small solid particles, bacteria and also dissolved compounds. This influence can be determined by comparing the supplied broad radio frequency spectrum to the filter with the outgoing signal, for example, preferably as function of time.

The antenna filter according to the invention can be used to characterize properties of this fluid, or fluid sample, by measuring the response by a receiver on an input signal from a transmitter. In a presently preferred embodiment of the invention, the dielectric permittivity of the fluid can be deduced from the measured response. The determined dielectric permittivity of the fluid between the first and second conductor is correlated to specific contents, like contaminations and other items mentioned above, in the fluid. This enables on-line measurement of a fluid to determine its contents. In fact, this enables the so-called on-line “fingerprinting” of a fluid. This can be applied in applications including monitoring of water quality, physical separation processes and chemical reactions in process industry. Also, the sensor will be able to detect aggregates of molecules, such as primary crystals and can be useful to monitor and control crystallization and scaling processes, for example. This results in an effective and efficient manner to measure such fluid.

Depending on the applied input signal for the antenna filter according to the invention, and the measured response thereof, it is shown in experiments that the presence of a broad range of components in the fluid can be detected. Furthermore, also the concentrations of the detected components in the fluid can be determined with the antenna filter according to the present invention as function of the characteristics of the input signal, like amplitude and frequency. This even further improves the possibilities for on-line “fingerprinting” of a fluid in an efficient and effective manner.

In a presently preferred embodiment, the first conductor is provided as a co-axial cable with a solid metal or tubing. This first conductor is surrounded by the second conductor comprising a metal tubing. This results in a relatively compact antenna filter of a co-axial type. As an illustrative explanation for this specific embodiment, below the characteristic impudent of the transmission line is calculated from the diameters of the first inner conductor and second outer conductor with a dielectric permittivity of insulating material

$$Z_0 = \frac{138.2}{\sqrt{\varepsilon r}} lg \frac{D}{d}$$

Z_0 – Characteristic impedance [Ohm].

D – Diameter of outer conductor [m].

d – Diameter of inner conductor [m].

ε_r – Relative dielectric permittivity i.e., $\varepsilon_r = \frac{\epsilon fluid}{\epsilon_0}$, where is ε_{fluid} = absolute dielectric permittivity of the solution applied as dielectric and ε_0 = absolute dielectric permittivity of vacuum = $8{,}85\ 10^{-12}\,(\frac{F}{m})$

For a first diameter of 4 mm and second diameter of 32 mm this would result, in case of the fluid being drinking water with a relative dialectic permittivity of 70, in a characteristic impedance of 15 Ohm.

With the antenna filter according to the present invention, it is possible to measure a fluid on-line with a relatively high sensitivity, such that specific information on components present in the fluid is available in an effective and efficient manner. This would enable to determine the presence of dissolved components in the fluid, like particles and bacteria, for example. By relating the dielectric permittivity of the fluid and the frequency of the input signal, preferably taking into account the temperature and viscosity of the fluid, information on the presence of different types of particles and/or molecules is provided. Particles and/or molecules each have a specific response to changes in the electric field. This enables measurement of a fluid in an effective and efficient manner.

In a preferred embodiment according to the present invention, the antenna filter is an open line quarter wave length co-axial antenna filter.

By providing the filter as a quarter wave length open line co-axial filter, changes in fluid composition can be detected. This is achieved as the resonant frequency of the filter depends on the length of this filter and the dielectric between the first and second conductor, i.e., on the dielectric properties of the fluid between the conductors.

In a presently preferred embodiment of the present invention, the quarter wave length antenna filter is provided with a first inner conductor of a co-axial cable with a solid metal or tubing and a second outer conductor provided with metal tubing surrounding the first conductor. This results in a compact filter design.

Preferably, the filter comprises an open end. Such open line filter, that in use is filled with fluid, behaves like a series resonant circuit. Therefore, at resonance, this filter has minimum impedance resulting in “short-circuit” of the signal supplied by the function generator. As this generator has an internal resistance that is often not negligible, the short-circuit at resonance will result in a potential drop over the system. This drop can be measured by a spectrum analyzer. This results in an effective filter that can be used for measuring a fluid efficiently.

In a preferred embodiment according to the present invention, the inner and/or outer conductors are insulated.

By insulating the inner and/or outer conductors, and most preferably both, the sensitivity of the filter for the measurement of the fluid is improved significantly. In fact, the detection levels of components in the fluid can be relatively low.

In a further preferred embodiment according to the present invention, the filter further comprises a dielectric for adsorbing components in a fluid.

By providing a dielectric in the filter, the sensitivity of the filter can be increased significantly. These dielectrics adsorb components that are present in the fluid, like water. In one of the presently preferred embodiments of the invention, the dielectric comprises an ion exchange resin. Preferably, this ion exchange resin is provided as spherical particles with a diameter in the range of about 0.1 mm tot 2.5 mm. Such particles can be provided as a dielectric between the first and second conductor of the filter. The particles will adsorb components that are present in the water. Periodically, the fluid feed to the filter is stopped and a detailed analysis of the complex dielectric permittivity as function of frequency can be performed. Next, the observed dielectric behaviour is correlated to the type and concentration of adsorbed components to the particles. This means that the detection levels for the filter for detecting the presence of a specific component in the fluid is lowered. Also, other dielectrics with specific adsorption properties can be applied as alternative to the ion exchange resin.

In a further preferred embodiment according to the present invention, the antenna filter is a flow-through filter.

Providing the filter as a flow-through filter enables on-line measurement of a fluid, thereby preventing the taking of samples of such fluids.

Especially in combination with the use of a dielectric, like the added particles of an ion exchanging resin, between the first and second conductor, such flow-through filter is used in an advantageous manner. As the fluid flows through the dielectric the particles will gradually adsorb components that are present in the fluid. This not only prevents the taking of samples, it also further minimizes the detection levels of components in the fluid.

The present invention also relates to a sensor system for measuring a fluid, the system comprising:

- an antenna filter as described above; and
- a transmitter connected to a receiver through a transmission line.

Such device provides the same effects and advantages as those stated with reference to the antenna filter. In the sensor system, the transmitter provides an input signal, preferably as a broad radio frequency spectrum, to the filter, with the response measured by a receiver and/or spectrum analyser. The transmitter and receiver are connected through a transmission line. The response is a measure of properties of the fluid, like the dielectric permittivity thereof. The measurement can be correlated to the presence of components, and possibly also the concentrations thereof, in the fluid. This provides an effective and efficient sensor system. Experiments have shown that applying an input signal by a transmitter comprising a frequency in the range of 20 MHz to 2 GHz provides optimal results on the detection of components and the concentrations thereof in a fluid.

The present invention further also relates to a method for measuring a fluid, the method comprising the steps of:

- providing a sensor system as described above;
- supplying the fluid to the filter;
- applying a frequency signal from the transmitter to the receiver; and
- measuring a response of the applied signal.

Such method provides the same effects and advantages as those stated with reference to the sensor system and filter. By measuring the response of the supplied signal, an indication of at least some of the properties of the fluid is achieved. Preferably, the properties of the fluid comprise the dielectric constant of this fluid. This dielectric constant of the fluid, or more specifically, the dielectric permittivity in preferably different frequency ranges, indicates the presence of a specific component, and preferably also the concentrations thereof, in the fluid. Therefore, the method preferably comprises the step of correlating the measure properties to specific components or contents, and optionally the concentrations thereof, that are present in the fluid. After this correlating of properties to specific contents, the presence of such contents in the fluid can be determined.

Further advantages, features and details of the invention are elucidated on basis of preferred embodiments thereof, wherein reference is made to the accompanying drawings, wherein:

- Figure 1 illustrates a schematic overview of the filter according to the present invention;

- Figure 2 illustrates a schematic overview of a sensor system according to the present invention;

- Figure 3 illustrates the electric equivalent of the system of Figure 2; and

- Figures 4 to 12 show experimental results with the filter and sensor system according to the present invention.

A filter 2 (Figure 1) comprises a co-axial cable 4. Cable 4 comprises a solid metal or tubing 6 that is insulated. Metal or tubing 6 acts a conductor. Around cable 4 is provided a metal tubing 8 that acts as another conductor. Tubing 8 is provided at a distance of cable 4. This distance defines a volume 10 between conductors 6, 8 that in use is at least partially filled by a fluid to be measured.

A sensor system 12 (Figure 2) comprises a transmitter 14 that is connected to a receiver 16 through a transmission line 18. Transmission line 18 is connected to the earth 20. Transmission line 18 is further connected to a filter 22. Filter 22 comprises a first conductor 24 that is insulated with insulation material 26 and a second conductor 28. The volume 30 between the conductors 24, 28 is filled with fluid 32.

Sensor system 22 can be represented with electrical equivalent 34 (Figure 3). Circuit 34 comprises a function generator 36 and a resistance (R1) 40. Circuit 34 further comprises filter 42 with a capacitor (C3) 44, inductor (L3) 46 and a resistance (R2) 48. Measurements are performed with a spectrum analyzer 50 comprising a resistance (R3) 52 and analyzer (VM1) 54. It will be understood that this is a simplified representation of the spectrum analyzer 50. Capacitors (C1) 56 and (C2) 58 represent, together with inductors (L1) 60 and (L2) 62 the 50 Ohm co-axial line from the function generator to the open line filter. Capacitors (C4) 64 and (C5) 66 represent, together with inductors (L4) 68 and (L5) 70, the 50 Ohm co-axial line from the filter to the analyzer.

From the electrical equivalent 34 it will be understood that the open line co-axial cable that can be filled with a fluid behaves like a series resonant circuit. This means that this open line co-axial cable has minimum impedance and resonance, resulting in short-circuit of the signals supplied by the function generator. As the function generator has a significant internal resistance, such short-circuit and resonance will result in a potential drop over resistor (R3) that can be measured by the spectrum analyzer 50. As the resonant frequency of the filter 42 depends also on the dielectric between inner and outer conductors 24, 32 changes in the water composition will result in changes of the resonant frequency.

By supplying a frequency input signal by the transmitter 14, 36 receiver 16, 50 picks up the response. This response depends, amongst other things, on the characteristics of the filter 12, 42 that is filled with the fluid to be measured. From the response, the dielectric permittivity of the fluid can be determined. This dielectric permittivity is correlated to one or more specific components, and preferably also the concentrations thereof can be detected.

Optionally, in volume 30 between the conductors 24, 28 dielectric, preferably shaped as spherical ion exchange resin particles with a diameter in the range of 0.1 - 2.5 mm, is provided to increase the sensitivity of the sensor system 34.

Experiments

Experiments have been performed with the sensor system 12 as illustrated in Figure 2 with the electrical equivalent thereof illustrated in Figure 3. The set-up was such, that in the electrical equivalent thereof R1 = 50 Ohm, R3 = 50 Ohm. Signal generator 36 was HP8657B, analyzer 50 a HP8594E spectrum analyzer. Filter 22, 42 comprises a PVC tube with an internal diameter of 25 mm wherein an insulated conductor 24 was provided with a diameter of 4 mm. The total length of the tube was 130 mm. Also, tubes with a total length of 100 mm and a diameter of 32 mm were used, also containing insulated inner conductor 24 with a diameter of 4 mm. The measurements were performed in a laboratory at a temperature of about 21°C using for the input signal a frequency range of 20 MHz to 2 GHz. In the experiments, the amplitude of the input signal was set to a fixed value. Subsequently, the amplitude of the measured signal by the spectrum analyzer was measured as function of frequency.

Figure 4 shows the amplitude versus frequency plot with air and sunflower oil as dielectric in the filter, with the frequency in MHz and the amplitude in mV with measured results for air being indicated with triangles, and for sunflower oil indicated with squares. From the results, it can be seen that the difference between air and sunflower oil, although the relative dielectric permittivities of both substances are relatively close to each other, can be detected. Measured base resonant frequency for air is 590 MHz and for sunflower oil 400 MHz.

Figure 5 shows results of a similar experiment with tap water (indicated with squares) and ethanol (indicated with triangles). From the measurements, it can be concluded that the measured base resonant frequencies for tap water is 210 MHz and for ethanol 220 MHz with the peaks of the next harmonic considerably different for both fluids, i.e. for tap water 620 MHz and for ethanol 720 MHz.

The results shown in Figures 4 and 5 clearly indicate that the filter according to the present invention is technically feasible to discriminate between different dielectrics.

Figures 6 - 9 show results of an amplitude versus frequency plot for tap water (indicated with squares) and tap water with different concentrations of dissolved sodium chlorite (diamonds indicating 0.0427 mol/L NaCl solution, triangles pointing downwards 0.855 mol/L NaCl, triangles pointing upwards 5.128 mol/L NaCl. In the figures the frequencies are shown in MHz and the amplitude in mV.

Figure 6 illustrates an overview of the measured responses, while Figure 7 zooms in on the frequency range of 100 - 300 MHz, Figure 8 to 500 - 800 MHz, and Figure 9 to 850 - 1150 MHz. From the results can be concluded that differences between tap water and water containing different amounts of sodium chlorite can be detected with the filter according to the present invention. Figure 7 shows that in the frequency range of 100 - 300 MHz the resonant frequency of the filter decreases with increasing salt concentration in the water. It is also shown that a minimum of the amplitude of the resonant frequency increases with increasing salt concentrations. This indicates that the quality factor of the quarter wave length open line co-axial filter decreases when salt is added to the tap water used as dielectric. A higher salt concentration results in a higher loss factor due to higher conductivity of the solution.

With a filter having a length of 130 mm, a diameter of 25 mm, a fluid level of 100 mm and an inner conductor that is about 10 mm higher than the fluid level in the filter, another experiment is performed. Results of this experiment are shown in Figure 10 with the frequency in MHz and the amplitude in mV, showing results for tap water (indicated with squares) and de-ionized water (indicated with diamonds). The experiment was performed at about 20°C with the filter being filled with 40 ml of fluid. This fluid was injected into the antenna filter using an injection syringe, so that the level of the fluid in the filter was the same in all experiments. Figure 10 shows that the difference between both the fluids is detected by a shift of the resonance frequency of the filter.

Figure 11 shows results of another amplitude versus frequency plot with the 25 mm diameter filter for both ethanol (indicated with diamonds) and tap water (indicated with squares). Also, this experiment was performed at about 20°C in the 25 mm diameter filter at a fluid level of 88 mm, which means that the filter contained 35 ml of fluid. The inner conductor was about 22 mm higher than the fluid level in the filter.

Figure 12 shows an additional amplitude versus frequency plot for tap water (indicated with squares) and non-mixed tap water and ethanol (indicated with diamonds) and mixed tap water and ethanol (indicated with triangles), under similar conditions as previous experiments. As shown in this case, the differences between the different fluids can be detected. This indicates the influence of different process conditions under filter performance for measuring a fluid.

The experiments indicate that so-called “fingerprinting” of a fluid can be done by supplying a broad array of frequencies spectrum to the filter and studying the outgoing signal, preferably as a function of time. From the dynamic response of the filter to changing water quality, it is possible to discriminate between solid particles, bacteria and dissolved components.

The present invention is by no means limited to the above described embodiments thereof. The protection sought is defined by the following claims, within the scope of which many modifications can be envisaged.

Clauses

1. Antenna filter for measuring a fluid, the filter comprising:
   - a first conductor; and
   - a second conductor placed at a distance from the first conductor, wherein the distance between the first and second conductors defines a volume that in use holds the fluid to achieve a fluid containing transmission line.

2. Antenna filter according to clause 1, wherein the filter is an open line quarter wave length coaxial antenna filter.

3. Antenna filter according to clause 1 or 2, wherein the filter comprises an open end.

4. Antenna filter according to clause 1, 2 or 3, wherein the first and/or second conductors are insulated.

5. Antenna filter according to any of clauses 1-4, the filter further comprising a dielectric for adsorbing components in the fluid.

6. Antenna filter according to clause 5, wherein the dielectric comprises ion exchange resin.

7. Antenna filter according to clause 5 or 6, wherein the dielectric comprises spherical particles with a diameter in the range of 0.1 mm to 2.5 mm.

8. Antenna filter according to any of clauses 1-7, wherein the filter is a flow-through filter.

9. Sensor system for measuring a fluid, comprising:
   - an antenna filter according to any of clauses 1-8; and
   - a transmitter connected to a receiver through a transmission line.

10. Sensor system according to clause 9, wherein the transmitter applies an input signal comprising a frequency in the range of 20 MHz - 2 GHz.

11. Method for measuring a fluid, comprising the steps of:
   - providing a sensor system according to clause 9 or 10;
   - supplying the fluid to the filter;
   - applying a frequency signal from the transmitter to the receiver; and
   - measuring a response of the applied signal.

12. Method according to clause 11, wherein the measured response is a measure for properties of the fluid comprising a dielectric constant of the fluid.

13. Method according to clause 11 or 12, further comprising the step of correlating the measured properties to specific components of the fluid.

14. Method according to clause 13, further comprising the step of determining the specific components of the fluid.

Conclusies

1. Antennefilter voor het meten van een fluïdum, het filter omvattende:
- een eerste geleider; en
- een tweede geleider geplaatst op een afstand van de eerste geleider, waarbij de afstand tussen de eerste en tweede geleider een volume definieert dat in gebruik het fluïdum bevat voor het realiseren van een fluïdum bevattende transmissielijn.

2. Antennefilter volgens conclusie 1, waarin het filter een open lijn kwartsgolflengte co-axiale antennefilter betreft.

3. Antennefilter volgens conclusie 1 of 2, waarin het filter een open einde omvat.

4. Antennefilter volgens conclusie 1, 2 of 3, waarin de eerste en/of tweede geleiders geïsoleerd zijn.

5. Antennefilter volgens één of meer van de conclusies 1-4, het filter verder omvattende een dielektricum voor het adsorberen van componenten in het fluïdum.

6. Antennefilter volgens conclusie 5, waarin het dielektricum omvattende ion uitwisselende hars.

7. antennefilter volgens conclusie 5 of 6, waarin het dielektricum omvattende sferische deeltjes met een diameter in het bereik van 0,1 tot 2,5 mm.

8. Antennefilter volgens één of meer van de conclusies 1-7, waarin het filter een doorstromingsfilter betreft.

9. Sensorsysteem voor het meten van een fluïdum, omvattende:
- een antennefilter volgens één of meer van de conclusies 1-8; en
- een zender verbonden met een ontvanger door een transmissielijn.

10. Sensorsysteem volgens conclusie 9, waarin de zender een ingangsignaal toepast omvattende een frequentie in het bereik van 20 MHz - 2 GHz.

11. Method for measuring a fluidum, omvattende de stappen:
- het voorzien van een sensorsysteem volgens conclusie 9 of 10;
- het toevoeren van het fluïdum naar het filter;
- het toepassen van een frequentiesignaal van de zender naar de ontvanger; en
- het meten van een responsie op het toegepaste signaal.

12. Werkwijze volgens conclusie 11, waarin de gemeten responsie een maat is voor eigenschappen van fluïdum omvattende een dielektrische constante van het fluïdum.

13. Werkwijze volgens conclusie 11 of 12, verder omvattende de stap van het correleren van gemeten eigenschappen aan specifieke componenten van het fluïdum.

14. Werkwijze volgens conclusie 13, verder omvattende de stap van het vaststellen van de specifieke componenten van het fluïdum.

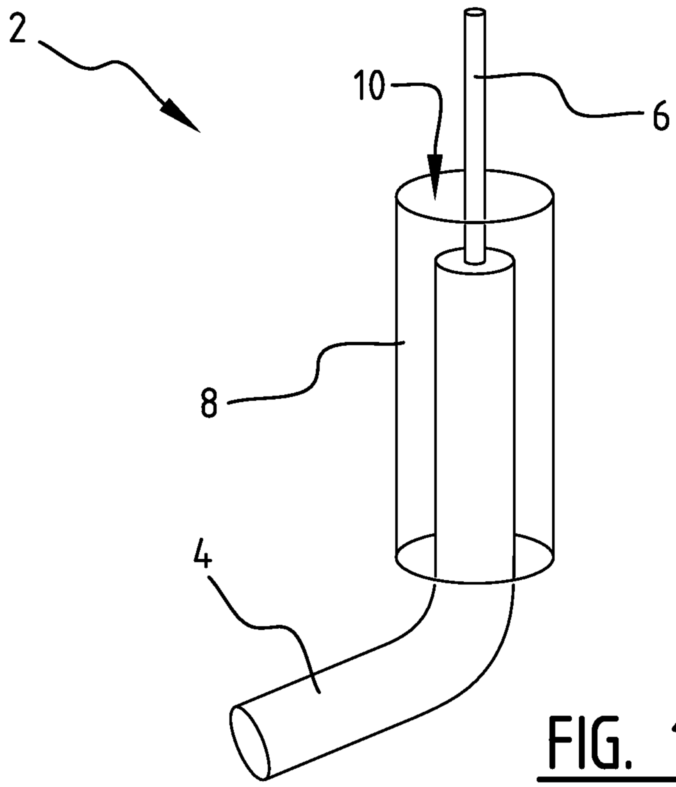


FIG. 1

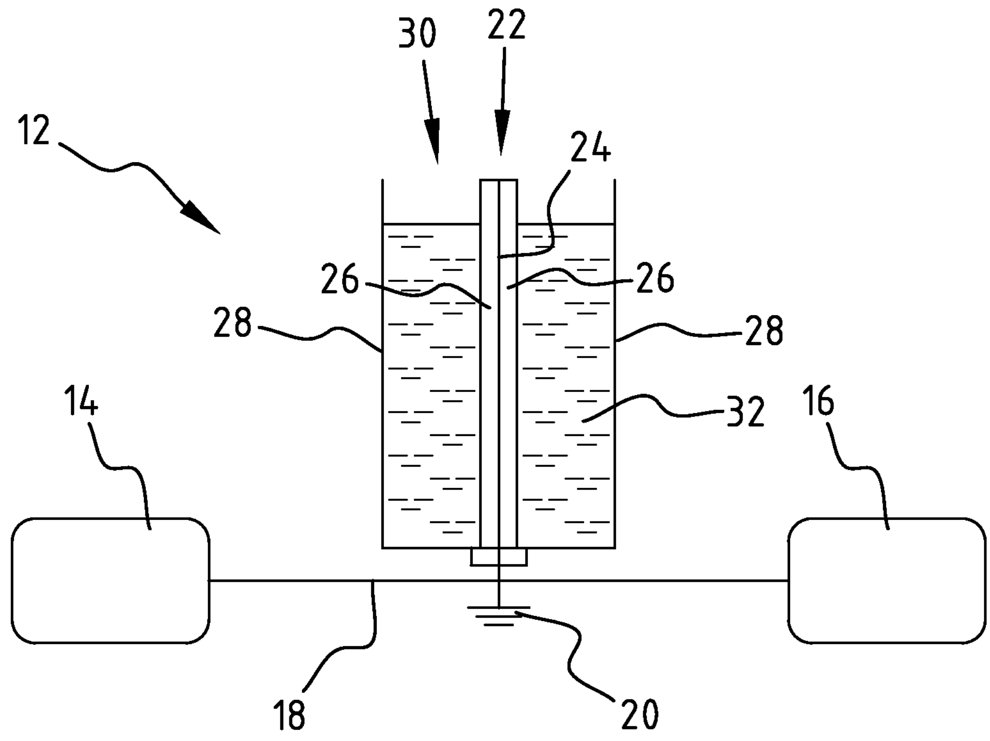


FIG. 2

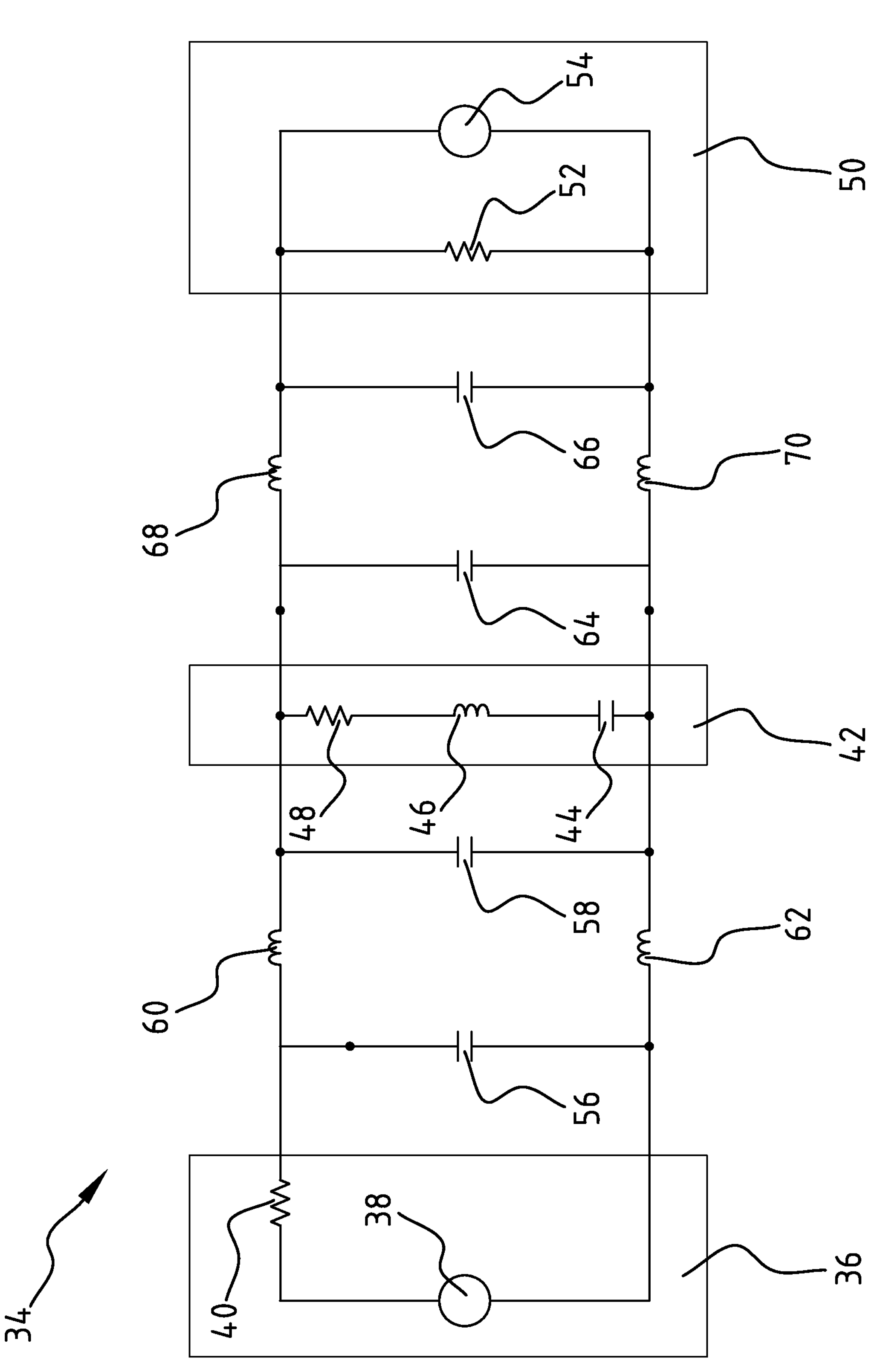


FIG. 3

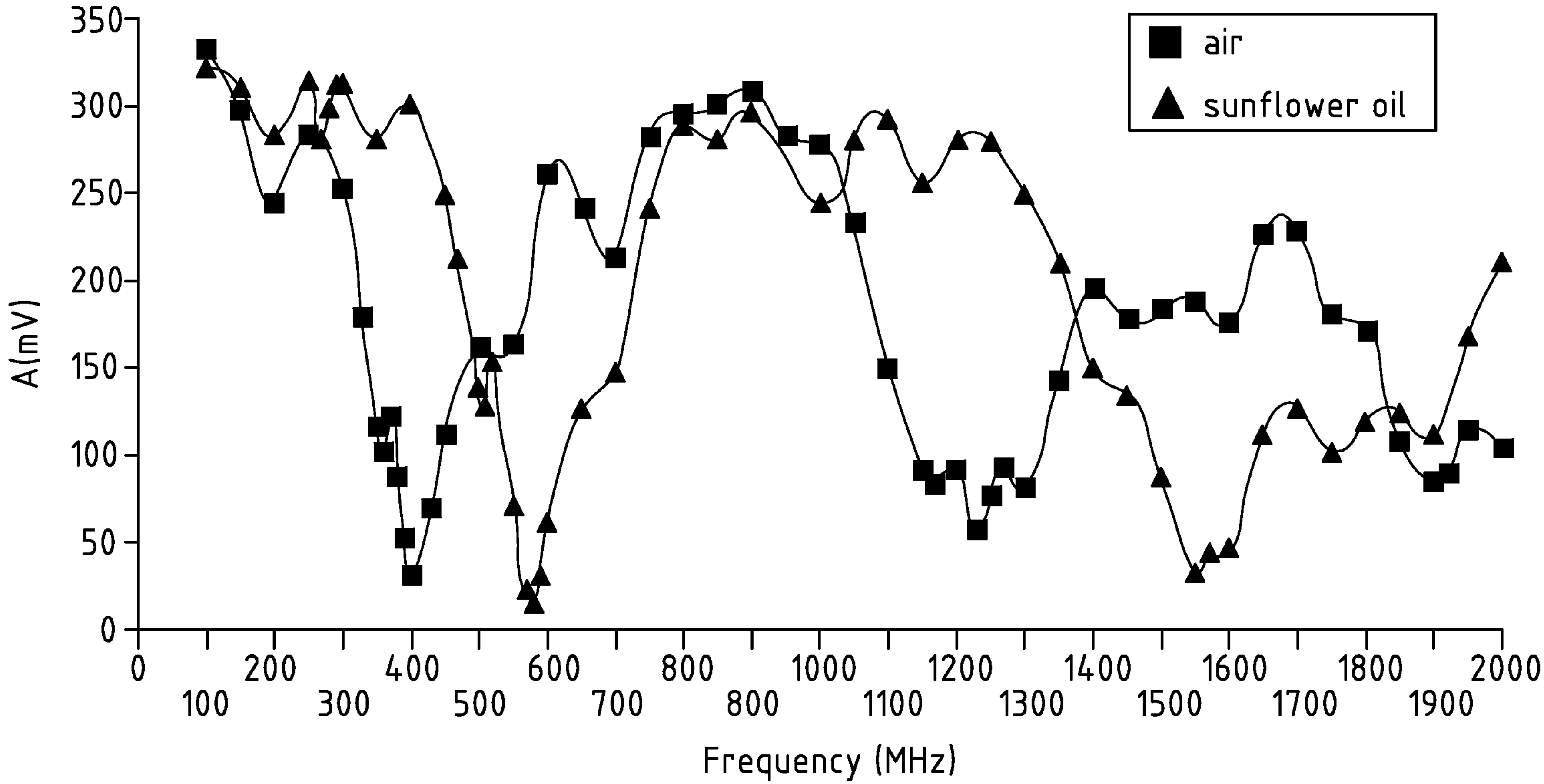
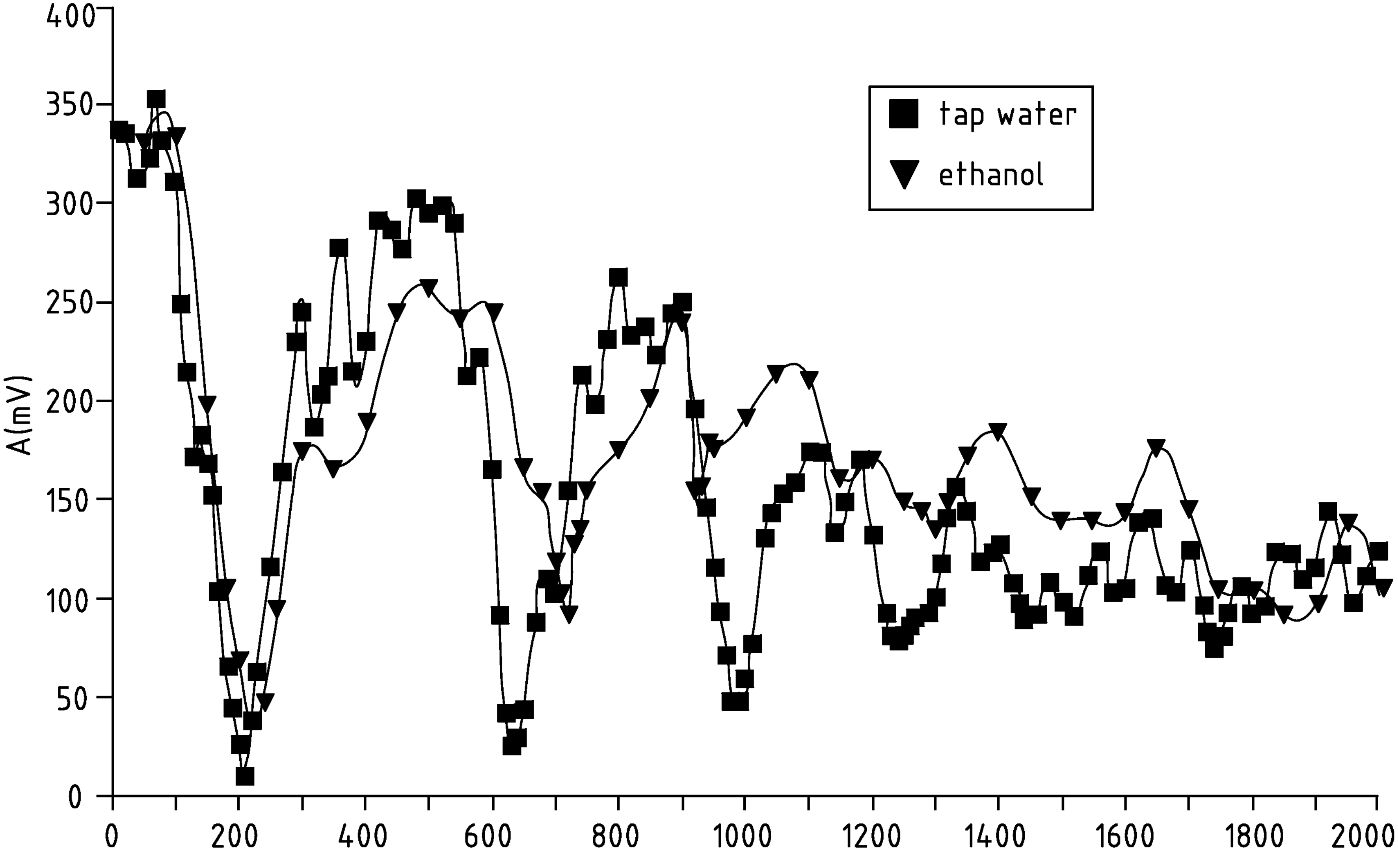
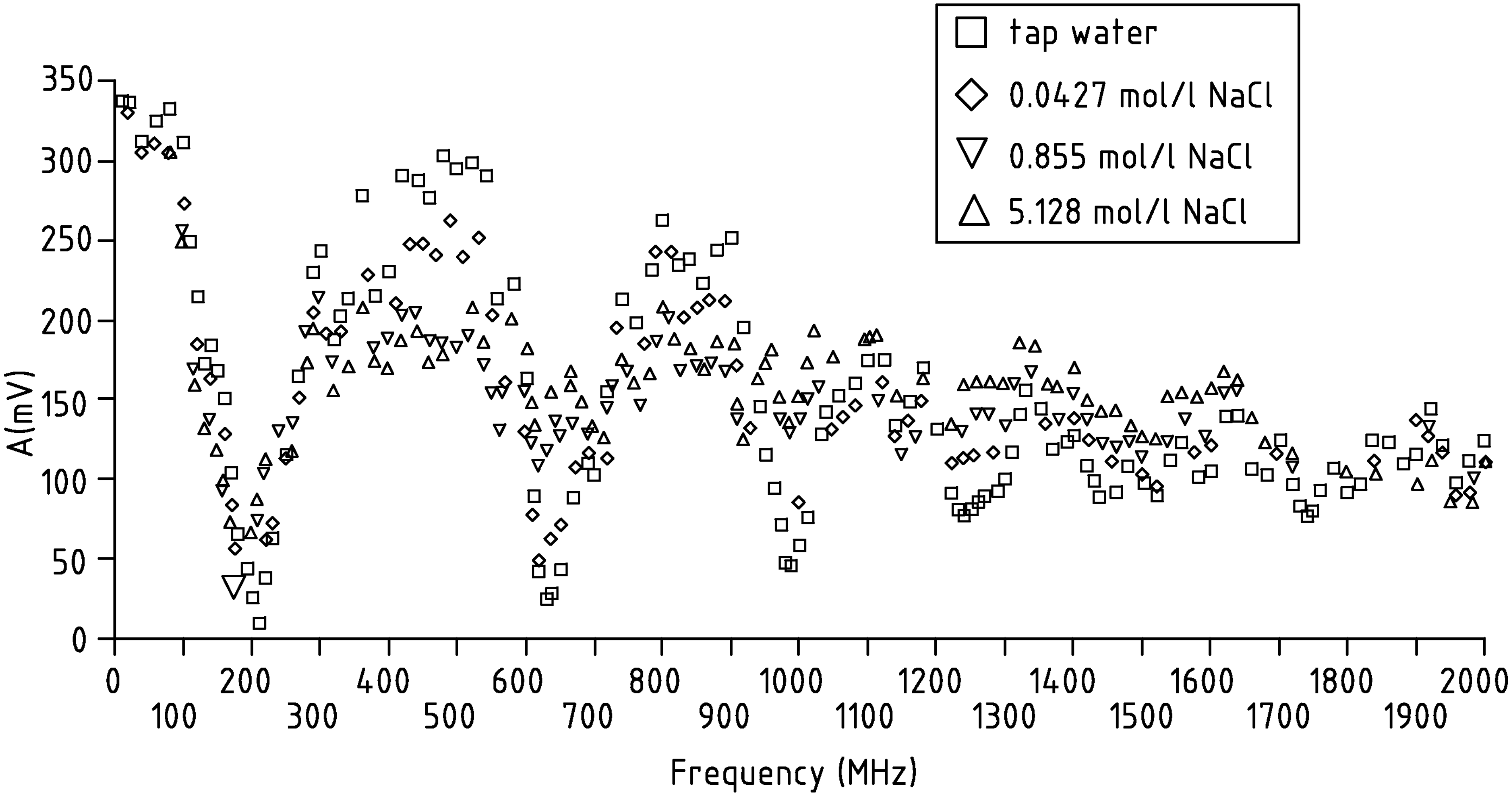

air
sunflower oil
A(mV)
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
100
300
500
700
800
1100
1300
1500
1700
1900
Frequency (MHz)

FIG. 4



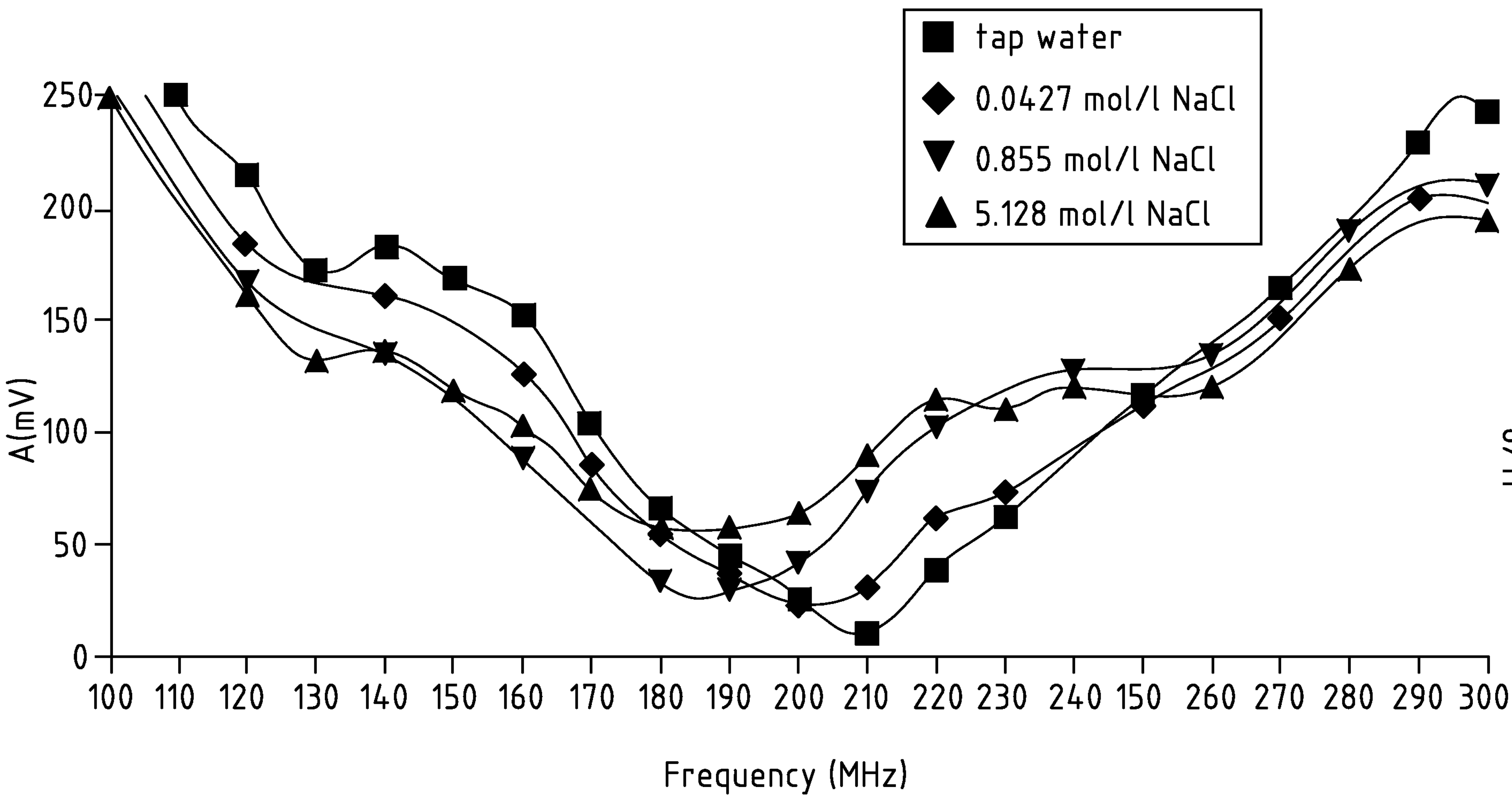
400
350
300
250
200
150
100
50
0
A(mV)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Frequency (MHz)
tap water
ethanol

FIG. 5



tap water
0.0427 mol/l NaCl
0.855 mol/l NaCl
5.128 mol/l NaCl
A(mV)
0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Frequency (MHz)

FIG. 6



tap water
0.0427 mol/l NaCl
0.855 mol/l NaCl
5.128 mol/l NaCl
A(mV)
250
200
150
100
50
0
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
150
260
270
280
290
300
Frequency (MHz)

FIG. 7

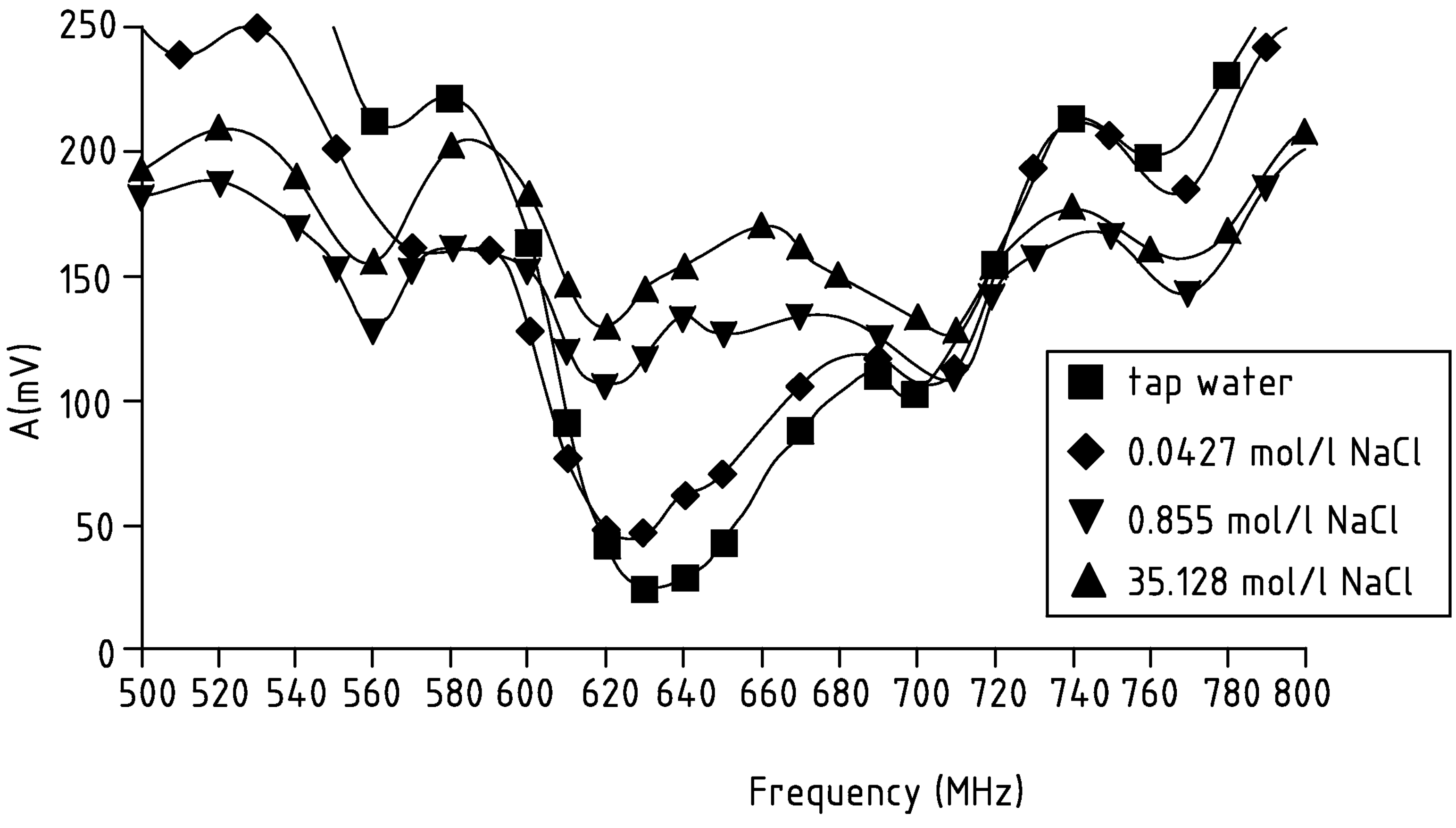

A(mV)
250
200
150
100
50
0
500 520 540 560 580 600 620 640 660 680 700 720 740 760 780 800
Frequency (MHz)
tap water
0.0427 mol/l NaCl
0.855 mol/l NaCl
35.128 mol/l NaCl

FIG. 8

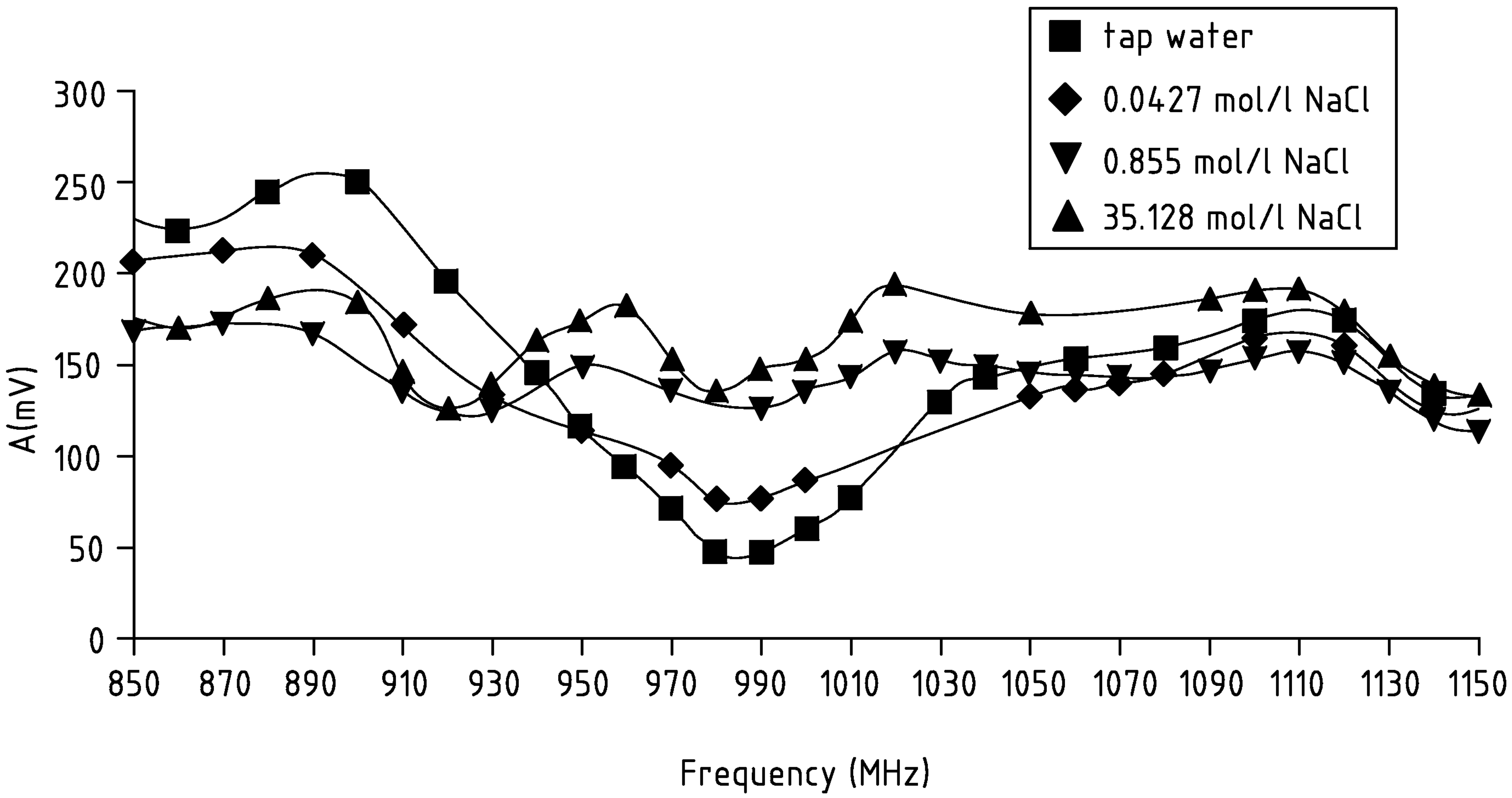
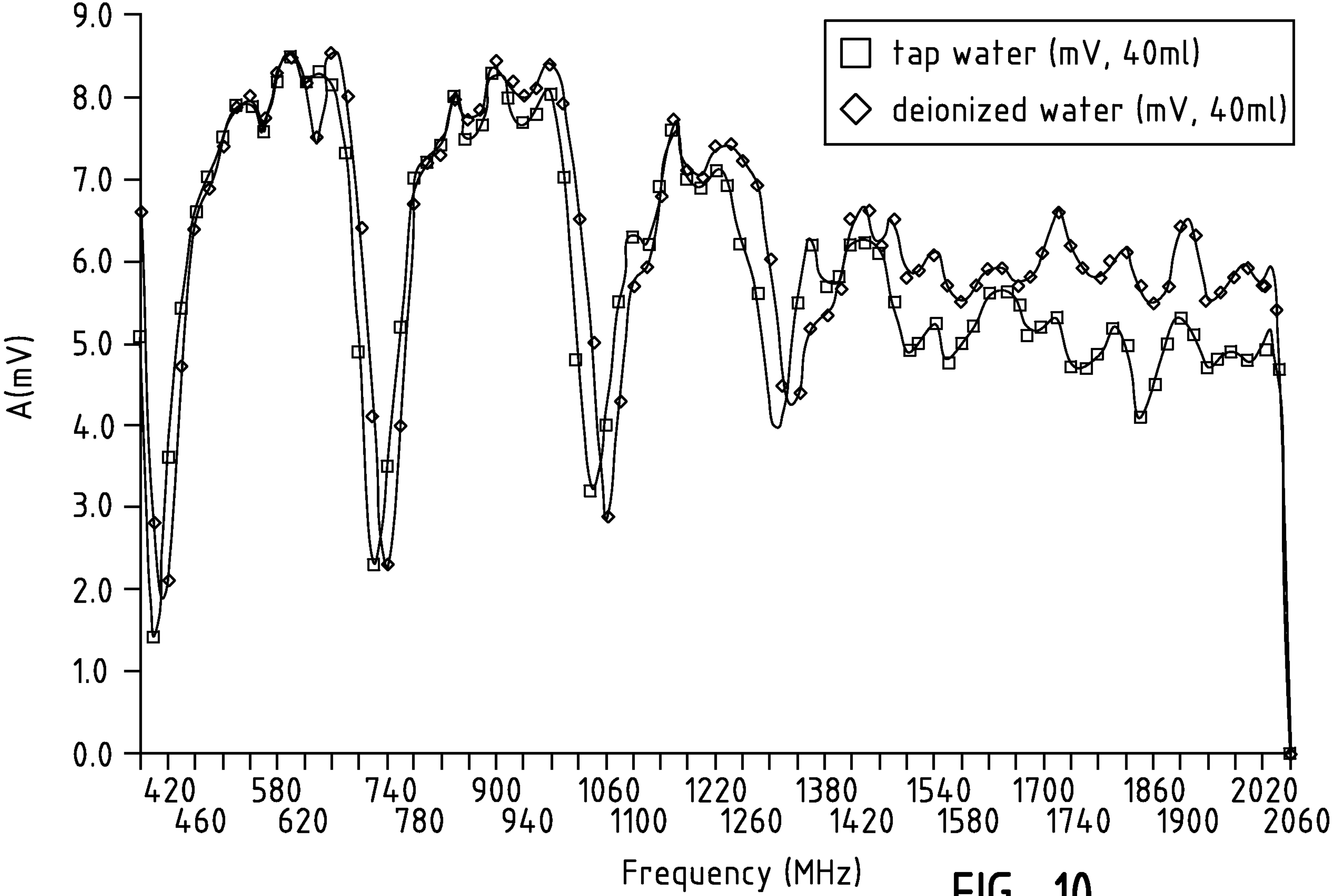

tap water
0.0427 mol/l NaCl
0.855 mol/l NaCl
35.128 mol/l NaCl
A(mV)
300
250
200
150
100
50
0
850
870
890
910
930
950
970
990
1010
1030
1050
1070
1090
1110
1130
1150
Frequency (MHz)

FIG. 9



tap water (mV, 40ml)
deionized water (mV, 40ml)
A(mV)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
420
460
580
620
740
780
900
940
1060
1100
1220
1260
1380
1420
1540
1580
1700
1740
1860
1900
2020
2060
Frequency (MHz)

FIG. 10

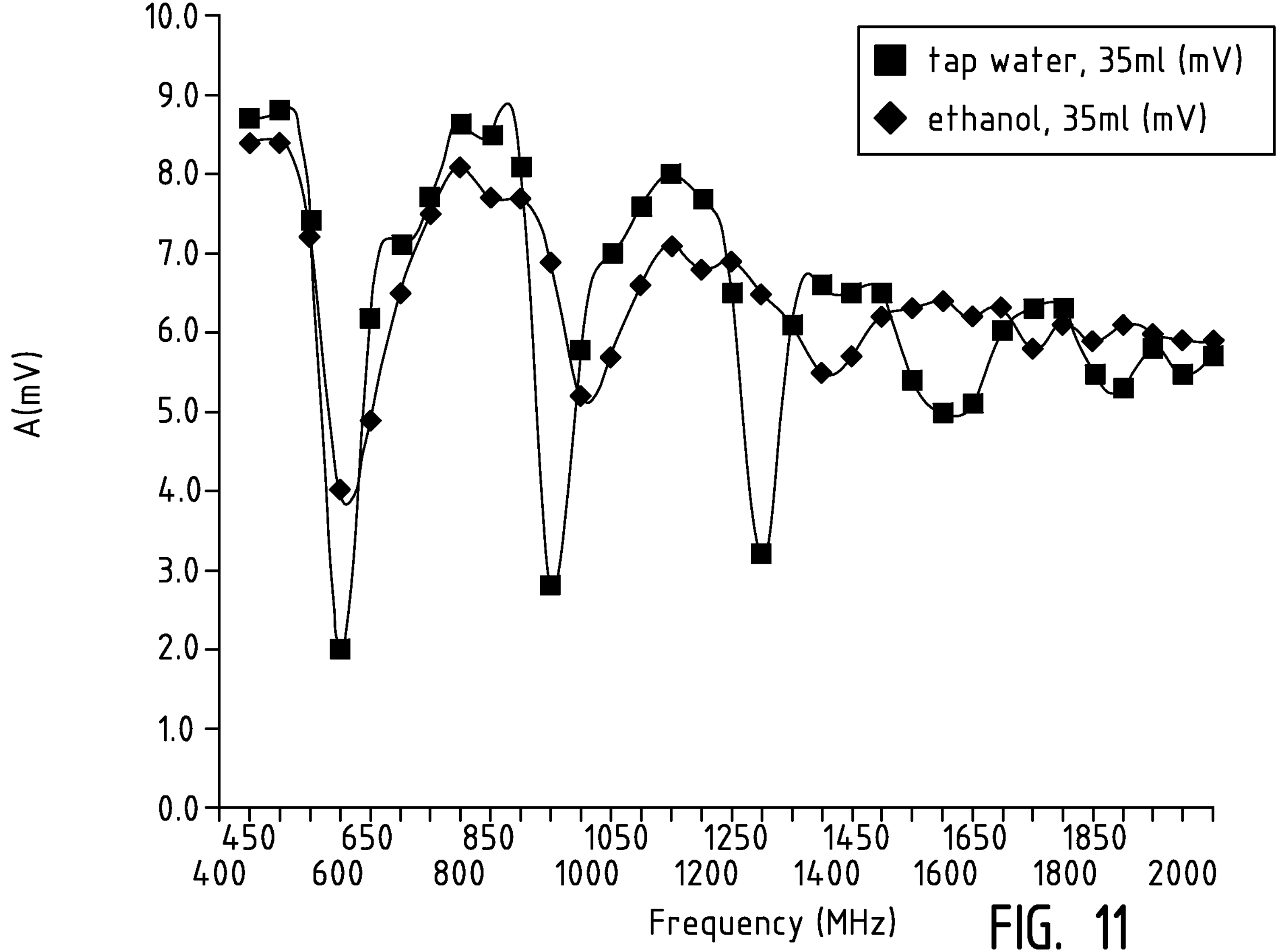

tap water, 35ml (mV)
ethanol, 35ml (mV)
A(mV)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
450
650
850
1050
1250
1450
1650
1850
400
600
800
1000
1200
1400
1600
1800
2000
Frequency (MHz)

FIG. 11

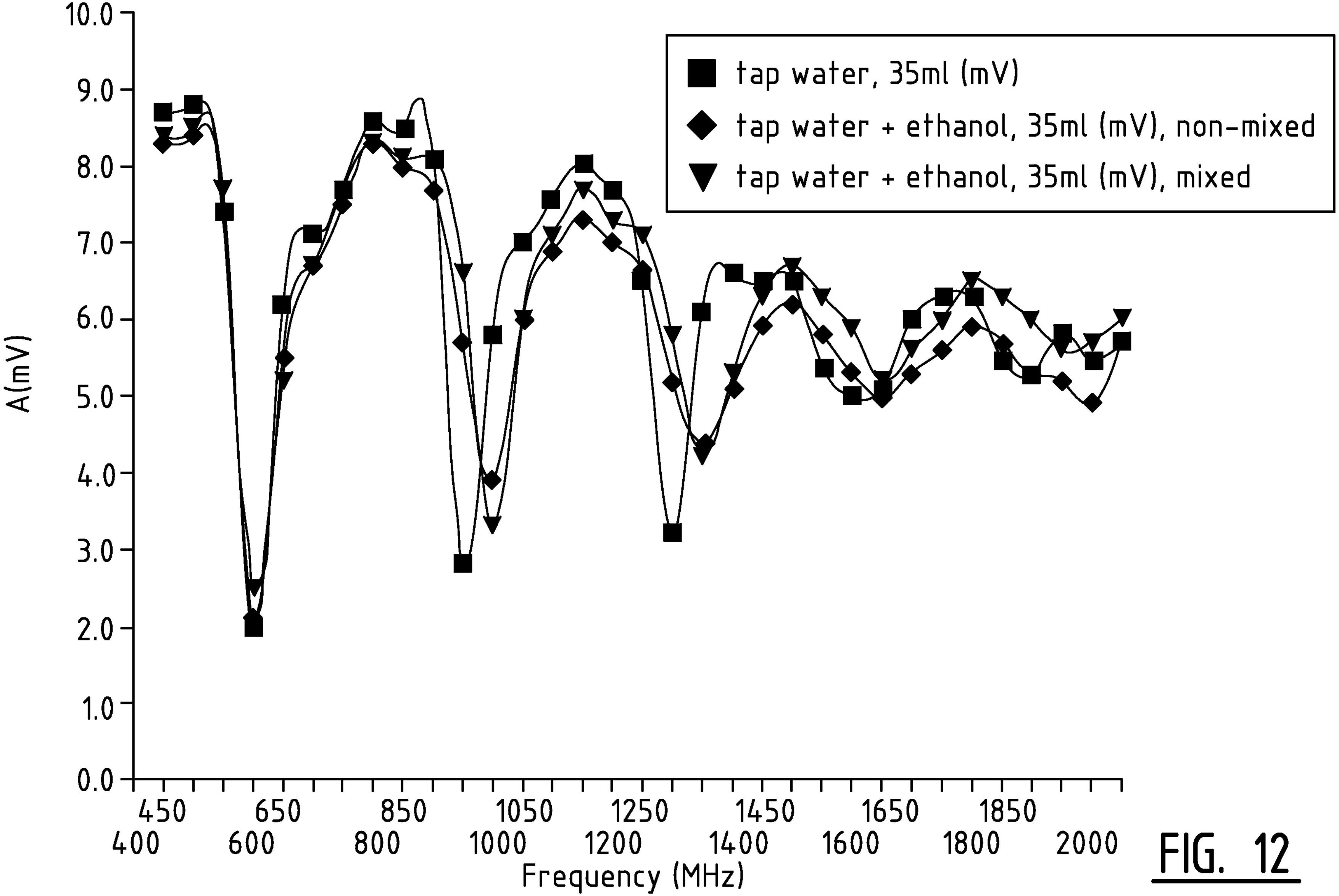

tap water, 35ml (mV)
tap water + ethanol, 35ml (mV), non-mixed
tap water + ethanol, 35ml (mV), mixed
A(mV)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
450
650
850
1050
1250
1450
1650
1850
400
600
800
1000
1200
1400
1600
1800
2000
Frequency (MHz)

FIG. 12

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	2L/2GZ47/MvD/27
Nederlands aanvraag nr. **2003136**	Indieningsdatum **06-07-2009**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **St.Wetsus Centre of Excellence for Sustaiable Water Technology**	
Datum van het verzoek voor een onderzoek van internationaal type **03-11-2009**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN 53168**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

G01N22/00

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie	
Classificatiesysteem	Classificatiesymbolen
IPC 8	**G01N**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐	**GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☐	**GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2003136

A. CLASSIFICATIE VAN HET ONDERWERP
INV. G01N22/00

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
G01N

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)

EPO-Internal

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 4 996 490 A (SCOTT BENTLEY N [US] ET AL) 26 februari 1991 (1991-02-26) * kolom 3, regel 34 - kolom 4, regel 58; figuur 1 * -----	1,4-5, 8-14
X	GB 2 110 377 A (ITT IND LTD) 15 juni 1983 (1983-06-15) * samenvatting; figuren * -----	1,4,8-14
X	DE 10 2006 034884 A1 (ADEMICS GBR; KLASS DANNEN; 39104 MAGDEBURG; FRANK STEYER; TOBIAS MEYER) 5 april 2007 (2007-04-05)	1-3,9-14
Y	* samenvatting; figuur * -----	5-7
Y	EP 1 726 361 A2 (CULLIGAN INT CO [US]) 29 november 2006 (2006-11-29) * samenvatting; figuur 1 * -----	5-7

☐ Verdere documenten worden vermeld in het vervolg van vak C.

☒ Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft
"D" in de octrooiaanvrage vermeld
"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven
"L" om andere redenen vermelde literatuur
"O" niet-schriftelijke stand van de techniek
"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding
"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur
"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht
"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
3 maart 2010	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Wilhelm, Jörg

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek

NL 2003136

In het rapport genoemd octrooigeschrift		Datum van publicatie	Overeenkomend(e) geschrift(en)			Datum van publicatie
US 4996490	A	26-02-1991	GEEN			
GB 2110377	A	15-06-1983	ES	8401259	A1	16-02-1984
DE 102006034884	A1	05-04-2007	GEEN			
EP 1726361	A2	29-11-2006	AU	2006201727	A1	14-12-2006
			CA	2545948	A1	26-11-2006
			CN	1880237	A	20-12-2006
			JP	2006326585	A	07-12-2006
			KR	20060122776	A	30-11-2006
			NZ	546762	A	30-11-2006
			SG	127794	A1	29-12-2006
			US	2006266710	A1	30-11-2006

OCTROOICENTRUM NEDERLAND

WRITTEN OPINION

File No. SN53168	Filing date *(day/month/year)* 06.07.2009	Priority date *(day/month/year)*	Application No. NL2003136
International Patent Classification (IPC) INV. G01N22/00			
Applicant Stichting Wetsus Centre of Excellence for Sustaina			

This opinion contains indications relating to the following items:

- ☒ Box No. I — Basis of the opinion
- ☐ Box No. II — Priority
- ☐ Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV — Lack of unity of invention
- ☒ Box No. V — Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI — Certain documents cited
- ☐ Box No. VII — Certain defects in the application
- ☐ Box No. VIII — Certain observations on the application

	Examiner Wilhelm, Jörg

WRITTEN OPINION

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	6-7
	No:	Claims	1-5, 8-14
Inventive step	Yes:	Claims	
	No:	Claims	1-14
Industrial applicability	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations

   see separate sheet

D1 US 4 996 490 A (SCOTT BENTLEY N [US] ET AL) 26 februari 1991 (1991-02-26)

Document D1 discloses an apparatus and a method for measurements on fluids, using two conductors (16, 22) defining a volume to hold the fluid and to achieve a fluid containing transmission line.

All features of independent claims 1 and 11 are known from D1, the subject-matter of these claims is not new.

Dependent claims 2-10 and 12-14 do not appear to contain any additional features which, in combination with the features of claim 1, meet the requirements of novelty and/or inventive step.