

**PATENT COOPERATION TREATY**

**PCT**

**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44bis)

Applicant's or agent's file reference CHP-016-PCT	<b>FOR FURTHER ACTION</b>		See item 4 below
International application No. PCT/US2015/063242	International filing date ( <i>day/month/year</i> ) 01 December 2015 (01.12.2015)	Priority date ( <i>day/month/year</i> )	
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237			
Applicant CHIRP MICROSYSTEMS, INC.			

<p>1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 bis.1(a).</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.</p>																								
<p>3. This report contains indications relating to the following items:</p> <table> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. I</td> <td>Basis of the report</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table> <p>4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44bis.3(c) and 93bis.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44bis .2).</p>	<input checked="" type="checkbox"/>	Box No. I	Basis of the report	<input type="checkbox"/>	Box No. II	Priority	<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	<input type="checkbox"/>	Box No. IV	Lack of unity of invention	<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	<input type="checkbox"/>	Box No. VI	Certain documents cited	<input type="checkbox"/>	Box No. VII	Certain defects in the international application	<input type="checkbox"/>	Box No. VIII	Certain observations on the international application
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	Date of issuance of this report 05 June 2018 (05.06.2018)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer  Agnès Wittmann-Regis
Facsimile No. +41 22 338 82 70	e-mail: pct.team6@wipo.int

## PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To: JOSHUA D. ISENBERG  
C/O JDI PATENT  
809 CORPORATE WAY  
FREMONT, CA 94539

PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing (day/month/year) 07 APR 2016	
Applicant's or agent's file reference CHP-016-PCT	<b>FOR FURTHER ACTION</b> See paragraph 2 below
International application No. PCT/US 15/63242	International filing date (day/month/year) 01 December 2015 (01.12.2015)
Priority date (day/month/year)	
International Patent Classification (IPC) or both national classification and IPC IPC(8) - B06B 1/06 (2016.01) CPC - H01L 41/053, H01L 41/081, B06B 1/0292, B06B 1/06, B06B 1/0651, B06B 2201/55, B06B 2201/51	
Applicant CHIRP MICROSYSTEMS, INC.	

## 1. 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 under Rule 43bis.1(a)(i) 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 international application
- Box No. VIII Certain observations on the international application

## 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1 bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Date of completion of this opinion 18 March 2016 (18.03.2016)	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774
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WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

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## Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:
  - the international application in the language in which it was filed.
  - a translation of the international application into \_\_\_\_\_ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2.  This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a)).
3.  With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
  - a.  forming part of the international application as filed:
    - in the form of an Annex C/ST.25 text file.
    - on paper or in the form of an image file.
  - b.  furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
  - c.  furnished subsequent to the international filing date for the purposes of international search only:
    - in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
    - on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4.  In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

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Box No. V	Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement						
1.	Statement						
	Novelty (N)	Claims	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border-bottom: 1px solid black;">4-8, 13, 16, 18-23, 25</td> <td style="text-align: right; vertical-align: bottom;">YES</td> </tr> <tr> <td style="border-bottom: 1px solid black;">1-3, 9-12, 14-15, 17, 24, 26</td> <td style="text-align: right; vertical-align: bottom;">NO</td> </tr> </table>	4-8, 13, 16, 18-23, 25	YES	1-3, 9-12, 14-15, 17, 24, 26	NO
4-8, 13, 16, 18-23, 25	YES						
1-3, 9-12, 14-15, 17, 24, 26	NO						
	Inventive step (IS)	Claims	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border-bottom: 1px solid black;">None</td> <td style="text-align: right; vertical-align: bottom;">YES</td> </tr> <tr> <td style="border-bottom: 1px solid black;">1-26</td> <td style="text-align: right; vertical-align: bottom;">NO</td> </tr> </table>	None	YES	1-26	NO
None	YES						
1-26	NO						
	Industrial applicability (IA)	Claims	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border-bottom: 1px solid black;">1-26</td> <td style="text-align: right; vertical-align: bottom;">YES</td> </tr> <tr> <td style="border-bottom: 1px solid black;">None</td> <td style="text-align: right; vertical-align: bottom;">NO</td> </tr> </table>	1-26	YES	None	NO
1-26	YES						
None	NO						
	<p>2. Citations and explanations:</p> <p>Claims 1-3, 9-12, 14-15, 17, 24, 26 lack novelty under PCT Article 33(2) as being anticipated by WO 2009/096576 A2 to CANON.</p> <p>As per claim 1, CANON describes a micromachined ultrasound transducer (MUT) package (para[0001]-[0003]), comprising: a cavity characterized by a curved geometry (enclosed cavity, FIGS. 1-2; para[0030]-[0031],[0036]); and a MUT (bottom planar membrane portion of 103, generally at 106, with the reduced bulk density, FIG. 1; para[0030]-[0033]) mounted to a side of a substrate (unmodified bulk portion of the membrane 103, generally at 105, FIG. 1; para[0030]-[0033]) and facing the cavity with a sound emitting portion of the MUT facing an aperture (generally entire bulk reduced region with cavities 104, FIG. 1) in the substrate, wherein the substrate is disposed over an opening of the cavity with the substrate oriented such that the MUT is located within the cavity (see bottom planar membrane portion of 103 at 106, FIG. 1).</p> <p>As per claim 2, CANON describes the apparatus of claim 1, wherein the cavity is characterized by a cylindrical geometry (FIGS. 1-2; para[0038]).</p> <p>As per claim 3, CANON describes the apparatus of claim 2, wherein the cavity is characterized by a circular cylindrical geometry (FIGS. 1-2; para[0038]).</p> <p>As per claim 9, CANON describes the apparatus of claim 3, wherein a radius and height of the cavity are configured such that acoustic resonance modes of the cavity do not interfere with the MUT's operating frequency (para[0006]-[0011],[0026]).</p> <p>As per claim 10, CANON describes the apparatus of claim 2, wherein the MUT is centered with respect to a cylindrical symmetry axis of the cavity (FIGS. 1-2).</p> <p>As per claim 11, CANON describes the apparatus of claim 2, wherein the substrate is a top substrate (103) and the cavity is formed by a spacer (102) sandwiched between the top substrate and a bottom substrate (101), the spacer having a cylindrical opening formed therethrough (FIGS. 1-2; para[0030]).</p> <p>As per claim 12, CANON describes the apparatus of claim 11, wherein the MUT is mounted to a top substrate to completely cover an aperture in the top substrate (FIGS. 1-2).</p> <p>As per claim 14, CANON describes the apparatus of claim 2, wherein the substrate is a bottom substrate and the cavity is formed by a lid having a cylindrical cavity (note top and bottom comprises intended use the device is capable of - see 101, 102, 103; FIGS. 1-2; para[0030]).</p> <p>As per claim 15, CANON describes the apparatus of claim 14, wherein the MUT is mounted to the bottom substrate to completely cover an aperture in the substrate (FIGS. 1-2).</p> <p>As per claim 17, CANON describes the apparatus of claim 14, wherein the MUT is mounted inside the lid to completely cover an aperture in the lid (FIGS. 1-2).</p> <p>As per claim 24, CANON describes the apparatus of claim 1, wherein the sound emitting portion of the MUT includes a membrane disposed over an opening in a MUT substrate (see openings 104, FIG. 1).</p> <p>As per claim 26, CANON describes the apparatus of claim 1, wherein the MUT is a capacitive micromachined ultrasonic transducer (cMUT) (para[0003],[0013]).</p> <p>-----Please See Continuation Sheet-----</p>						

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## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

-----Box V.2. Citations and explanations-----

Claims 4-8, 13, 16, 18 lack an inventive step under PCT Article 33(3) as being obvious over CANON.

As per claim 4, CANON describes the apparatus of claim 3, but fails to describe wherein the cavity is characterized by a circular cylindrical geometry characterized by a cylinder radius of between 0.2 mm and 5mm. However, Canon describes altering the size for the intended frequency (para[0006]-[0011],[0026]). It would have been obvious to one skilled in the art, through routine experimentation, to supply the appropriate size, based on the resonant frequency on the intended use.

As per claim 5, CANON describes the apparatus of claim 4, but fails to describe wherein the cylinder radius is between 0.3 mm and 2.5mm.

However, Canon describes altering the size for the intended frequency (para[0006]-[0011],[0026]). It would have been obvious to one skilled in the art, through routine experimentation, to supply the appropriate size, based on the resonant frequency on the intended use.

As per claim 6, CANON describes the apparatus of claim 5, but fails to describe wherein the MUT is configured to operate at a frequency between 100 kHz and 600 kHz.

However, Canon describes altering the size for the intended frequency (para[0006]-[0011],[0026]). It would have been obvious to one skilled in the art, through routine experimentation, to supply the appropriate size, based on the resonant frequency on the intended use.

As per claim 7, CANON describes the apparatus of claim 4, but fails to describe wherein the cylindrical geometry is further characterized by a cylinder height in a range from 0.1 mm to 2 mm.

However, Canon describes altering the height for the intended frequency (para[0006]-[0011],[0026]). It would have been obvious to one skilled in the art, through routine experimentation, to supply the appropriate height, based on the resonant frequency on the intended use.

As per claim 8, CANON describes the apparatus of claim 4, but fails to describe wherein the cylinder height is in a range from 0.4 mm to 1 mm.

However, Canon describes altering the height for the intended frequency (para[0006]-[0011],[0026]). It would have been obvious to one skilled in the art, through routine experimentation, to supply the appropriate height, based on the resonant frequency on the intended use.

As per claim 13, CANON describes the apparatus of claim 12, but fails to describe specifically wherein an application specific integrated circuit (ASIC) is mounted to a bottom substrate and a plurality of electrical connections are made to the ASIC through the bottom substrate.

However, CANON does disclose the bottom substrate comprising an electrode with connections (para[0042]). It would have been obvious to one skilled in the art to place a ASIC here with the electrode, so as to make a more compact device depending on the intended final use.

As per claim 16, CANON describes the apparatus of claim 15, but fails to describe wherein an application specific integrated circuit (ASIC) is mounted alongside the MUT on a bottom substrate.

However, CANON does disclose the bottom substrate comprising an electrode with connections (para[0042]). It would have been obvious to one skilled in the art to place a ASIC here with the electrode, so as to make a more compact device depending on the intended final use.

As per claim 18, CANON describes the apparatus of claim 17, but fails to describe wherein an application specific integrated circuit (ASIC) is mounted to a bottom substrate and a plurality of electrical connections are made to the ASIC through the bottom substrate.

However, CANON does disclose the bottom substrate comprising an electrode with connections (para[0042]). It would have been obvious to one skilled in the art to place a ASIC here with the electrode, so as to make a more compact device depending on the intended final use.

Claims 19-23 lack an inventive step under PCT Article 33(3) as being obvious over CANON in view of CN 102430512 A to UNIV SOUTHEAST.

As per claim 19, CANON describes the apparatus of claim 1, but fails to describe wherein the cavity is characterized by a hemispherical geometry.

CANON does describe spherical and other geometry closed spaces (para[0068])

However UNIV SOUTHEAST describes such a device (Abstract) with a hemispherical cavity (7, FIG. 2). It would have been obvious to one skilled in the art to shape the cavity in any shape, such as semi-spherical so as to properly attenuate the desired frequency of intended resonance.

As per claim 20, CANON and UNIV SOUTHEAST describe the apparatus of claim 19, wherein the MUT is centered with respect to a hemispherical symmetry axis of the cavity (see CANON, FIGS. 1-2).

As per claim 21, CANON and UNIV SOUTHEAST describe the apparatus of claim 19, but fail to describe wherein the hemispherical geometry is characterized by a hemispherical radius between 0.2 mm and 3 mm.

However, UNIV SOUTHEAST describes the relationship between frequency and radius (FIG. 3), and Canon describes altering the size for the intended frequency (para[0006]-[0011],[0026]). It would have been obvious to one skilled in the art, through routine experimentation, to supply the appropriate size, based on the resonant frequency on the intended use.

As per claim 22, CANON and UNIV SOUTHEAST describe the apparatus of claim 19, but fail to describe wherein the hemispherical radius is between 0.3 mm and 2 mm.

However, UNIV SOUTHEAST describes the relationship between frequency and radius (FIG. 3), and Canon describes altering the size for the intended frequency (para[0006]-[0011],[0026]). It would have been obvious to one skilled in the art, through routine experimentation, to supply the appropriate size, based on the resonant frequency on the intended use.

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## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

-----Supplemental Box:-----

As per claim 23, CANON and UNIV SOUTHEAST describe the apparatus of claim 19, UNIV SOUTHEAST describes wherein wherein the MUT is configured to operate at a frequency between 100 kHz and 600 kHz (Abstract).

Claims 25 lack an inventive step under PCT Article 33(3) as being obvious over CANON in view of the Article titled Theory and Operation of 2-D Array Piezoelectric Micromachined Ultrasound Transducers to Dausch et al. (hereinafter: Dausch).

As per claim 25, CANON describes the apparatus of claim 1, but fails to describe wherein the MUT is a piezoelectric micromachined ultrasound transducer (pMUT).

However, CANON does describe both pMUT and cMUT (para[0001]-[0003]). Finally, Dausch describes a similar arrangement for pMUT (Abstract, FIG. 1). It would have been obvious to one skilled in the art to configure the elastic wave transducer in any configuration, such as a pMUT as disclosed by Dausch, depending on the final application requirements.

Claims 1-26 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.