

**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 171305-2020	<b>FOR FURTHER ACTION</b>		See item 4 below
International application No. PCT/US2017/012095	International filing date ( <i>day/month/year</i> ) 04 January 2017 (04.01.2017)	Priority date ( <i>day/month/year</i> ) 16 February 2016 (16.02.2016)	
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237			
Applicant MACOM TECHNOLOGY SOLUTIONS HOLDINGS, 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 7 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 checked="" 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 checked="" type="checkbox"/>	Box No. VIII	Certain observations on the international application
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	Date of issuance of this report 21 August 2018 (21.08.2018)
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# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

# PCT

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**  
(PCT Rule 43*bis*.1)

To:

see form PCT/ISA/220

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No. PCT/US2017/012095	International filing date (day/month/year) 04.01.2017	Priority date (day/month/year) 16.02.2016
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International Patent Classification (IPC) or both national classification and IPC  
INV. H03D7/02

Applicant  
MACOM TECHNOLOGY SOLUTIONS HOLDINGS, 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 43*bis*.1(a)(i) with regard to novelty, inventive step and 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 usually 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.

<p>Name and mailing address of the ISA:</p>  <p>European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465</p>	<p>Date of completion of this opinion</p> <p>see form PCT/ISA/210</p>	<p>Authorized Officer</p> <p>Schnabel, Florian</p> <p>Telephone No. +49 89 2399-0</p> 
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**Box No. I Basis of the opinion**

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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**

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1. Statement

Novelty (N)	Yes: Claims	<u>11-15</u>
	No: Claims	<u>1-10</u>
Inventive step (IS)	Yes: Claims	
	No: Claims	<u>1-15</u>
Industrial applicability (IA)	Yes: Claims	<u>1-15</u>
	No: Claims	

2. Citations and explanations

see separate sheet

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**Box No. VIII Certain observations on the international application**

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The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

- D1 SHUAN-MING LI ET AL: "A 24GHz sub-harmonically image rejection mixer with various asymmetrical diode pair", MICROWAVE AND MILLIMETER WAVE TECHNOLOGY (ICMMT), 2010 INTERNATIONAL CONFERENCE ON, IEEE, PISCATAWAY, NJ, USA, 8 May 2010 (2010-05-08), pages 521-524, XP031717448, ISBN: 978-1-4244-5705-2
- D2 HWANN-KAEO CHIOU ET AL: "A Miniature -Band Balanced Sub-Harmonically Pumped Image Rejection Mixer", IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS, IEEE SERVICE CENTER, NEW YORK, NY, US, vol. 17, no. 6, 1 June 2007 (2007-06-01), pages 463-465, XP011182725, ISSN: 1531-1309, DOI: 10.1109/LMWC.2007.897849
- D3 US 2005/191985 A1 (BOS THOMAS A [US] ET AL) 1 September 2005 (2005-09-01)

1 The present application does not meet the criteria of Article 33(2) PCT, because the subject-matter of independent **claims 1** is not new.

1.1 Using the wording of present **claim 1**, the document D1 discloses (the references in parentheses applying to this document):

*An apparatus (D1: Fig. 1a, Fig. 5; D2: Fig. 1a, Fig. 3; D3: Fig. 4B, Fig. 5B) comprising:*

*a first circuit (D1: upper diode pair in Fig. 1a and Fig. 5; D2: first diode pair from above in Fig. 1a and Fig. 3; D3: upper diode pair in Fig. 4B and Fig. 5B) in a substrate and comprising a first diode and a second diode (i) connected as anti-parallel diodes and (ii) physically adjacent to each other in said substrate; and*

*a second circuit (D1: lower diode pair in Fig. 1a and Fig. 5; D2: second diode pair from above in Fig. 1a and Fig. 3; D3: lower diode pair in Fig. 4B and Fig.*

5B) *in said substrate and comprising a third diode and a fourth diode (i) connected as anti-parallel diodes and (ii) physically adjacent to each other in said substrate,*

*wherein*

*said first circuit and said second circuit are (a) connected in parallel, (b) physically adjacent to each other in said substrate and (c) configured to mix two input signals (D1: IF, LO in Fig. 1a; D2: RF, LO in Fig. 1a; D3: IF or RF and LO in Fig. 4B) to generate an output signal and (D1: RF in Fig. 1; D2: IF in Fig. 1a; D3: RF or IF in Fig. 4B)*

*each neighboring physical structure in said first circuit and said second circuit that forms a diode junction is physically oriented in an opposite direction along a surface of said substrate (see layout connections in Fig. 5, Fig. 3 and Fig. 5B of D1, D2 and D3, respectively).*

- 1.2 In conclusion, the subject-matter of **claim 1** is anticipated by either one of D1, D2 or D3.
- 2 Dependent **claims 2 - 15** do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to novelty and/or inventive step.
- 2.1 **Claim 2, 3:** Not novel over either one of D2 or D3 as the mixer circuits cited therein above refer to a down-conversion apparatus (D2: section "II. CIRCUIT DESIGN"; D3: par. 7 & 66, Fig. 11).
- 2.2 **Claim 4, 5:** Not novel over either one of D1 or D3 as the mixer circuits cited therein above refer to an up-conversion apparatus (D1: section "II. PROPOSED CIRCUIT DESIGN"; D3: par. 7, Fig. 12) using the sum of the input frequencies (D3: par. 38-39).
- 2.3 **Claim 6 - 8:** Not novel over either one of D1, D2 or D3 as the mixer circuits cited therein above show the claimed layout features
- 2.4 **Claim 9:** Not novel over either one of D2 or D3 as the down-conversion mixer circuits cited therein above use the difference between the double LO frequency and the RF frequency (D2: section "II. CIRCUIT DESIGN"; D3: par. 33).

- 2.5 **Claim 10:** Not novel over either one of D1 or D3 as the up-conversion mixer circuits cited therein above use the difference between the double LO frequency and the RF frequency (D1: section "II. PROPOSED CIRCUIT DESIGN"; D3: par. 33).
- 2.6 **Claim 11 - 15:** Not inventive over either one of D1, D2 or D3 as the filtering of input or output signals of a mixer circuit is common practice in the art (see e.g. 133, 134 in Fig.4B in D3).

### Re Item VIII

#### **Certain observations on the international application**

- 3 The application does not meet the requirements of Article 6 PCT, because **claims 1, 6, 9 and 10** are not clear.

#### **Claim 1:**

- 3.1 The expression *physically oriented* is not self explanatory with respect to a *physical structure* nor is the term *each neighboring structure* clearly defined. It is not clear which part of the diode structure (junction, diffusion, wiring, ...) is intended to be included in that expression. It is also not clear how the orientation of any of those structures is defined.
- 3.2 The expression *in an opposite direction* is not clear without a reference direction.

#### **Claim 6:**

- 3.3 The syntax of the claim wording appears to be corrupt, as the expression from *said second diode* appears to be incomplete.

#### **Claim 9, 10:**

- 3.4 It is not clear whether the mathematical symbol " $\pm$ " corresponds to "+ and -" or "+ or -".