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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/268,765	02/06/2019	Kai-Sheng LIN	PAT266-002US

CONFIRMATION NO. 3070

PUBLICATION NOTICE



OC000000119016728

27543
APPLIED OPTOELECTRONICS, INC.
13115 JESS PIRTLE BLVD.
SUGAR LAND, TX 77478

Title:TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

Publication No.US-2020-0251879-A1

Publication Date:08/06/2020

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <https://portal.uspto.gov/pair/PublicPair>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/268,765	07/14/2020	10714890	PAT266-002US	3070

27543 7590 06/24/2020
APPLIED OPTOELECTRONICS, INC.
13115 JESS PIRTLE BLVD.
SUGAR LAND, TX 77478

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Kai-Sheng LIN, Sugar Land, TX;
Applied Optoelectronics, Inc., Sugar Land, TX;
Hsiu-Che WANG, Rosenberg, TX;
Kevin LIU, Houston, TX;

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Issue Classification 	Application/Control No. 16/268,765	Applicant(s)/Patent Under Reexamination LIN et al.
	Examiner ARMANDO RODRIGUEZ	Art Unit 2828

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47															
CLAIMS															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	10	18	19										
2	2		11	19	20										
3	3	11	12												
4	4	12	13												
5	5	13	14												
6	6	14	15												
7	7	15	16												
8	8	16	17												
9	9	17	18												

Change(s) applied
 to document,
 /K.D.D./
 6/5/2020

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 19	
/ARMANDO RODRIGUEZ/ Primary Examiner, Art Unit 2828 (Primary Examiner) _____ (Date) _____		04 May 2020 (Date)	O.G. Print Claim(s) 1 O.G. Print Figure 1

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

27543 7590 05/07/2020
APPLIED OPTOELECTRONICS, INC.
13115 JESS PIRTLE BLVD.
SUGAR LAND, TX 77478

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

April Davis	(Typed or printed name)
/April Davis/	(Signature)
June 4, 2020	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/268,765	02/06/2019	Kai-Sheng LIN	PAT266-002US	3070

TITLE OF INVENTION: TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	08/07/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
RODRIGUEZ, ARMANDO	2828	372-034000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Grossman Tucker Perreault
2 & Pfleger, PLLC
3 Norman S. Kinsella

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Applied Optoelectronics, Inc.

Sugar Land, Texas

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 50-1705

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Kenneth M. Thompson/

Date June 4, 2020

Typed or printed name Kenneth M. Thompson

Registration No. 72,001

Electronic Patent Application Fee Transmittal

Application Number:	16268765			
Filing Date:	06-Feb-2019			
Title of Invention:	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES			
First Named Inventor/Applicant Name:	Kai-Sheng LIN			
Filer:	Kenneth M. Thompson/April Davis			
Attorney Docket Number:	PAT266-002US			
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1000

Electronic Acknowledgement Receipt

EFS ID:	39626129
Application Number:	16268765
International Application Number:	
Confirmation Number:	3070
Title of Invention:	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES
First Named Inventor/Applicant Name:	Kai-Sheng LIN
Customer Number:	27543
Filer:	Kenneth M. Thompson/April Davis
Filer Authorized By:	Kenneth M. Thompson
Attorney Docket Number:	PAT266-002US
Receipt Date:	04-JUN-2020
Filing Date:	06-FEB-2019
Time Stamp:	13:31:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 1000
RAM confirmation Number	E202064D32135995
Deposit Account	501705
Authorized User	April Davis

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)
 37 CFR 1.20 (Post Issuance fees)
 37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	PAT266_002US_IssueFee_Transmittal.pdf	196827	no	1
			91d7c3fce76bbf183d4b2cd40b17838898f50096		

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30599	no	2
			dd4fee5350358034c15e1a36b1592dfc5ed40128		

Warnings:

Information:

Total Files Size (in bytes):			227426
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



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NOTICE OF ALLOWANCE AND FEE(S) DUE

27543 7590 05/07/2020
APPLIED OPTOELECTRONICS, INC.
13115 JESS PIRTLE BLVD.
SUGAR LAND, TX 77478

EXAMINER	
RODRIGUEZ, ARMANDO	
ART UNIT	PAPER NUMBER

2828

DATE MAILED: 05/07/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/268,765	02/06/2019	Kai-Sheng LIN	PAT266-002US	3070

TITLE OF INVENTION: TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	08/07/2020

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

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P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

27543 7590 05/07/2020
APPLIED OPTOELECTRONICS, INC.
13115 JESS PIRTLE BLVD.
SUGAR LAND, TX 77478

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/268,765	02/06/2019	Kai-Sheng LIN	PAT266-002US	3070

TITLE OF INVENTION: TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	08/07/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
RODRIGUEZ, ARMANDO	2828	372-034000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

1 _____

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

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3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

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5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

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NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/268,765	02/06/2019	Kai-Sheng LIN	PAT266-002US	3070
27543 7590 05/07/2020 APPLIED OPTOELECTRONICS, INC. 13115 JESS PIRTLE BLVD. SUGAR LAND, TX 77478				
EXAMINER RODRIGUEZ, ARMANDO				
ART UNIT PAPER NUMBER 2828				
DATE MAILED: 05/07/2020				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/268,765	Applicant(s) LIN et al.	
	Examiner ARMANDO RODRIGUEZ	Art Unit 2828	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 4/24/2020.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-10 and 12-20. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some *c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.

☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892) 2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____. 3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____. 4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.	5. ☐ Examiner's Amendment/Comment 6. ☒ Examiner's Statement of Reasons for Allowance 7. ☐ Other _____.
--	--

/ARMANDO RODRIGUEZ/
Primary Examiner, Art Unit 2828

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Response to Amendment

The 35 USC 112(b) rejection of claims 11, 16-19 are withdrawn based on applicant's amendment and arguments filed on April 24, 2020.

The 35 USC 102 rejection of claims 1 and 11 are withdrawn based on applicant's amendment and arguments filed on April 24, 2020.

The 35 USC 103 rejection of claim 16 is withdrawn based on applicant's amendment and arguments filed on April 24, 2020.

Allowable Subject Matter

Claims 1-10, 12-20 are allowed.

The following is an examiner's statement of reasons for allowance:

Regarding claims 1-10.

Independent claim 1 is allowed based on applicant's amendment and arguments filed on April 24, 2020, where the claim now includes the limitation "a base portion comprising a feedthrough device, the feedthrough device providing a vertical MPD mounting surface".

Claims 2-10 depend from claim 1.

Claims 12-15 were previously allowed in office action mailed on January 24, 2020.

Regarding claims 16-20.

Independent claim 16 is allowed based on applicant's amendment and arguments filed on April 24, 2020, where the claim now includes the limitation "a base portion comprising a feedthrough device, the feedthrough device providing a vertical MPD mounting surface".

Claims 17-20 depend from claim 16.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ARMANDO RODRIGUEZ whose telephone number is (571)272-1952. The examiner can normally be reached on M-F 9:00AM-5:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, JESSICA MANNO can be reached on 571-272-2339. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ARMANDO RODRIGUEZ/
Primary Examiner, Art Unit 2828

<i>Search Notes</i> 	Application/Control No. 16/268,765	Applicant(s)/Patent Under Reexamination LIN et al.
	Examiner ARMANDO RODRIGUEZ	Art Unit 2828

CPC - Searched*		
Symbol	Date	Examiner
H01S 5/02236, 0014, 02415, 4012, 4087, 02208, 02212, 02415	01/16/2020	AR
UPDATED SEARCH	05/04/2020	AR

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
EAST TERM SEARCH	01/16/2020	AR
INVENTOR NAME SEARCH	01/16/2020	AR
ASSIGNEE SEARCH	01/16/2020	AR
UPDATED SEARCH	05/04/2020	AR

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
CLAIM SEARCH		01/16/2020	AR

/ARMANDO RODRIGUEZ/ Primary Examiner, Art Unit 2828	
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Issue Classification 	Application/Control No. 16/268,765	Applicant(s)/Patent Under Reexamination LIN et al.
	Examiner ARMANDO RODRIGUEZ	Art Unit 2828

CPC						
Symbol					Type	Version
H01S	/	5	/	02236	F	2013-01-01
H01S	/	5	/	02415	I	2013-01-01
H01S	/	5	/	4012	I	2013-01-01
H01S	/	5	/	4087	I	2013-01-01
H01S	/	5	/	0014	I	2013-01-01

CPC Combination Sets				
Symbol	Type	Set	Ranking	Version
/				

NONE (Assistant Examiner) (Date)		Total Claims Allowed: 19	
/ARMANDO RODRIGUEZ/ Primary Examiner, Art Unit 2828 (Primary Examiner) (Date)		04 May 2020 (Date)	O.G. Print Claim(s) 1
			O.G. Print Figure 1

Issue Classification 	Application/Control No. 16/268,765	Applicant(s)/Patent Under Reexamination LIN et al.
	Examiner ARMANDO RODRIGUEZ	Art Unit 2828

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H01S5/022	/	5	/	022
H01S5/024	/	5	/	024
H01S5/40	/	5	/	40
H01S5/00	/	5	/	00
NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/ARMANDO RODRIGUEZ/ Primary Examiner, Art Unit 2828	04 May 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification 	Application/Control No. 16/268,765	Applicant(s)/Patent Under Reexamination LIN et al.
	Examiner ARMANDO RODRIGUEZ	Art Unit 2828

☐ Claims renumbered in the same order as presented by applicant
 ☐ CPA
 ☐ T.D.
 ☐ R.1.47

CLAIMS															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	10	18	19										
2	2		11	19	20										
3	3	11	12												
4	4	12	13												
5	5	13	14												
6	6	14	15												
7	7	15	16												
8	8	19	17												
9	9	17	18												

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/ARMANDO RODRIGUEZ/ Primary Examiner, Art Unit 2828	04 May 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1814	H01S5/02208.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 09:43
L2	258	1 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 09:44
L3	3719	H01S5/02212.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 09:51
L4	582	3 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 09:51
L5	760	H01S5/0222.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 10:04
L6	84	5 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 10:04
L7	2794	H01S5/02469.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 10:18
L8	224	7 and photodiode	US-PGPUB; USPAT;	OR	ON	2020/05/04 10:19

			USOCR; FPRS; EPO; JPO			
L9	3780	H01S5/02415.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 10:27
L10	713	9 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/04 10:27
S1	110	tosa and laser near3 diode and (mpd or (monitor near3 photodiode)) and hermetic\$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 13:27
S2	2	tosa and laser near3 diode near3 back near3 emission and (mpd or (monitor near3 photodiode)) and hermetic\$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 13:28
S3	191	tosa and laser near3 diode and (mpd or (monitor near3 photodiode)) and tec	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 13:57
S4	142	S3 not S1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 13:57
S5	436	tosa and laser near3 diode and (mpd or (monitor near3 photodiode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 15:28
S6	1598	H01S5/02236.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:02
S7	75	S6 and laser near3 diode and photodiode	US-PGPUB; USPAT;	OR	ON	2020/01/16 18:02

			USOCR; FPRS; EPO; JPO			
S8	2304	H01S5/0014.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:21
S9	214	S8 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:21
S10	3664	H01S5/02415.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:55
S11	492	S10 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:56
S12	4421	H01S5/4012.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 10:12
S13	207	S12 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 10:12
S14	5816	H01S5/4087.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 11:40
S15	314	S14 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 11:41
S16	1710	H01S5/02208.CPC.	US-PGPUB; USPAT;	OR	ON	2020/01/17 12:16

			USOCR; FPRS; EPO; JPO			
S17	130	S16 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 12:17
S18	3593	H01S5/02212.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:08
S19	404	S18 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:08
S20	741	H01S5/0222.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:30
S21	31	S20 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:30
S22	2569	H01S5/02469.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:33
S23	3664	H01S5/02415.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:33
S24	492	S23 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:33
S25	217	"Applied Optoelectronics".as.	US-PGPUB; USPAT;	OR	ON	2020/01/20 08:50

			USOCR; FPRS; EPO; JPO			
S26	49	S25 and tosa and laser near3 diode and (mpd or (monitor near3 photodiode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/20 08:51
S27	553	((kai near3 sheng near3 lin) or (hsiu near3 che near3 wang) or (kevin near3 liu)).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/20 09:17
S28	35	S27 and tosa and laser near3 diode and (mpd or (monitor near3 photodiode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/20 09:18
S30	446	tosa and laser near3 diode and (mpd or (monitor near3 photodiode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 10:08
S31	1703	H01S5/02236.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:00
S32	123	S31 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:01
S33	2411	H01S5/0014.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:06
S34	351	S33 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:06
S35	3780	H01S5/02415.CPC.	US-PGPUB; USPAT;	OR	ON	2020/05/01 12:14

			USOCR; FPRS; EPO; JPO			
S36	713	S35 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:14
S37	4689	H01S5/4012.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:37
S38	317	S37 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:37
S39	5991	H01S5/4087.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:49
S40	618	S39 and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/05/01 12:49

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S29	18	(tosa and laser near3 diode and (mpd or (monitor near3 photodiode))).clm.	US-PGPUB; USPAT	OR	ON	2020/01/20 09:13

5/4/2020 10:53:29 AM

C:\Users\arodriguez\Documents\EAST\Workspaces\16268765.wsp

Bibliographic Data

Application No: 16/268,765

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No ☐ Met After Allowance

Verified and Acknowledged:

/ARMANDO RODRIGUEZ/

Examiner's Signature

Initials

Title:

TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT
WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
02/06/2019	372	2828	PAT266-002US
RULE			

APPLICANTS

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INVENTORS

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Hsiu-Che WANG Rosenberg, TX, UNITED STATES

Kevin LIU Houston, TX, UNITED STATES

CONTINUING DATA

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

03/06/2019

STATE OR COUNTRY

UNITED STATES

ADDRESS

APPLIED OPTOELECTRONICS, INC.

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SUGAR LAND, TX 77478

UNITED STATES

FILING FEE RECEIVED

\$1,720

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Kai-Sheng LIN

Examiner: Rodriguez, Armando

Serial No.: 16/268,765

Group Art Unit: 2828 Conf. No.: 3070

Filed: February 6, 2019

Docket: PAT266-002US

Title: TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH
VERTICALLY-MOUNTED MONITOR PHOTODIODES

RESPONSE UNDER 37 C.F.R. § 1.111

This is in response to the Official Action in this case mailed on January 24, 2020. As this response is being filed within the three-month shortened statutory period of reply no extension of time is believed necessary. However, Applicant conditionally petitions for an extension of time to provide for the possibility that the need for an extension has inadvertently been overlooked. As provided below, please charge Deposit Account No. 50-1705 for any required fee, or for any deficiency in the enclosed fee.

- Claims, beginning at Page 2; and
- Remarks, beginning at Page 7.

IN THE CLAIMS

1. (Currently Amended) A transmitter optical subassembly (TOSA) module, the TOSA module comprising:

a laser diode (LD) mounting surface;

at least a first LD disposed on the LD mounting surface, the first LD having a back-side emission surface for emitting a portion of optical power along a first optical path;

a base portion comprising a feedthrough device, the feedthrough device providing a vertical MPD mounting surface; and

a first MPD disposed on the vertical MPD mounting surface, the first MPD having a light receiving region optically aligned with the first LD via the first optical path based at least in part on the vertical MPD mounting surface extending substantially transverse relative to the LD mounting surface such that the first optical path intersects with the light receiving region of the first MPD.

2. (Currently Amended) The TOSA module of claim 1, further comprising:

a housing having a plurality of sidewalls that define a cavity, the LD mounting surface being disposed in the cavity; and

~~a feedthrough device defined at least in part by the base,~~ wherein the feedthrough device is configured to at least partially be disposed in the cavity of the housing, and wherein a first end of the feedthrough device provides an electrical coupling region to electrically couple to an optical module substrate to receive a radio frequency (RF) driving signal to drive the first LD, and a second end of the feedthrough device defines the vertical MPD mounting surface, the vertical MPD mounting surface being disposed in the cavity.

3. (Original) The TOSA module of claim 2, wherein the cavity of the housing is hermetically sealed to prevent ingress of contaminants.

4. (Original) The TOSA module of claim 2, wherein at least one sidewall of the plurality of sidewalls of the housing provides a thermoelectric cooler (TEC) mounting section, and wherein the TOSA provides:

- a thermoelectric cooler (TEC) arrangement mounted to the TEC mounting section; and
- a LD submount disposed on the TEC arrangement, the LD submount being in thermal communication with the TEC arrangement, and wherein the LD submount provides the LD mounting surface.

5. (Original) The TOSA module of claim 1, further comprising a plurality of transmit (TX) radio frequency (RF) traces, the TX RF traces being disposed on a surface of the base that extends away from the vertical mounting surface along a direction that is substantially parallel with the LD mounting surface.

6. (Original) The TOSA module of claim 5, wherein the plurality of TX RF traces are disposed below the MPD when mounted to the vertical MPD mounting surface to allow the plurality of TX RF traces to extend towards the LD mounting surface, and wherein a portion of the plurality of TX RF traces are disposed adjacent the LD mounting surface.

7. (Original) The TOSA module of claim 1, further comprising a second LD disposed on the LD mounting surface and a second MPD disposed on the vertical MPD mounting surface, the second LD being configured to emit an associated channel wavelength different from that of the first LD, and wherein the second LD and second MPD are optically aligned via a second optical path such that the second optical path extends from a back-side emission surface of the second LD and intersects with a light receiving region of the second MPD.

8. (Original) The TOSA module of claim 7, further comprising a multiplexing arrangement, the multiplexing arrangement having at least first and second input ports optically aligned with the first and second optical paths, respectively, to receive and combine channel wavelengths emitted by the first and second LDs into a multiplexed optical signal for output via an output port.

9. (Original) The TOSA module of claim 8, wherein the multiplexing arrangement includes an arrayed waveguide grating AWG to multiplex the received channel wavelengths, and wherein AWG provides the output port and passes the multiplexed optical signal on to a transmit waveguide coupled to the output port.

10. (Original) The TOSA module of claim 8, wherein the first and second input ports of the multiplexing arrangement are angled relative to the light emitting region of the first and second LDs such that incident channel wavelengths received along the first and second optical paths intersect at an angle of about 8 degrees to prevent back reflection.

11. (Cancelled)

12. (Original) A method for optically coupling monitor photodiodes (MPDs) to corresponding laser diodes (LDs) in a multi-channel optical transceiver (TOSA) housing, the method comprising:

mounting at least one MPD to a vertical MPD mounting surface provided by a feedthrough device;

patterning a plurality of conductive traces on to one or more surfaces of the feedthrough device; and

inserting the feedthrough device into a cavity of the TOSA housing to bring the plurality of conductive traces into close proximity with the LDs in the TOSA, wherein inserting the feedthrough device into the cavity causes each of the at least one MPDs mounted to the vertical MPD mounting surface to optically couple with a back-side emission surface of each corresponding LD.

13. (Original) The method of claim 12, further comprising introducing an inert gas into the cavity to form a hermetic seal.

14. (Original) The method of claim 12, further comprising introducing wire bonds between the LDs and the plurality of conductive traces after insertion of the feedthrough device into the cavity of the TOSA housing.

15. (Original) The method of claim 12, wherein patterning the plurality of conductive traces includes disposing each conductive trace of the plurality of conductive traces on to a surface that extends below the vertical MPD mounting surface.

16. (Currently Amended) A multi-channel optical transceiver module comprising:
a printed circuit board assembly (PCBA);
a multi-channel transmitter optical subassembly (TOSA) arrangement coupled to the PCBA, the TOSA arrangement comprising:
a laser diode (LD) mounting surface;
at least a first LD disposed on the LD mounting surface, the first LD having a back-side emission surface for emitting a portion of optical power along a first optical path;
a base portion comprising a feedthrough device, the feedthrough device providing a vertical MPD mounting surface;
a first MPD disposed on the vertical MPD mounting surface, the first MPD having a light receiving region optically aligned with the first LD via the first optical path based at least in part on the vertical MPD mounting surface extending substantially transverse relative to the LD mounting surface such that the first optical path intersects with the light receiving region of the first MPD; and
a multi-channel receiver optical subassembly arrangement.

17. (Currently Amended) The multi-channel optical transceiver of claim 16, wherein the TOSA arrangement further comprises:

a TOSA housing having a plurality of sidewalls that define a cavity, the LD mounting surface being disposed in the cavity; and
~~a feedthrough device defined at least in part by the base, wherein~~ the feedthrough device is configured to at least partially be disposed in the cavity of the TOSA housing, and wherein a first end of the feedthrough device provides an electrical coupling region to electrically couple to an optical module substrate to receive a radio frequency

(RF) driving signal to drive the first LD, and a second end of the feedthrough device defines the vertical MPD mounting surface, the vertical MPD mounting surface being disposed in the cavity of the TOSA housing.

18. (Original) The multi-channel optical transceiver of claim 17, wherein the cavity of the TOSA housing is hermetically sealed to prevent ingress of contaminants.

19. (Original) The multi-channel optical transceiver of claim 17, wherein at least one sidewall of the plurality of sidewalls of the TOSA housing provides a thermoelectric cooler (TEC) mounting section, and wherein the TOSA provides:

- a thermoelectric cooler (TEC) arrangement mounted to the TEC mounting section; and
- a LD submount disposed on the TEC arrangement, the LD submount being in thermal communication with the TEC arrangement, and wherein the LD submount provides the LD mounting surface.

20. (Currently Amended) The multi-channel optical transceiver of claim [[15]] 16, further comprising a plurality of transmit (TX) radio frequency (RF) traces, the TX RF traces being disposed on a surface of the base portion that extends away from the vertical mounting surface along a direction that is substantially parallel with the LD mounting surface, and wherein the TX RF traces are disposed below the MPD when mounted to the vertical MPD mounting surface to allow the TX RF traces to extend towards the LD mounting surface.

REMARKS

Please reconsider the application in view of the following remarks. Applicant submits that the claims, as presented, are in condition for allowance and respectfully requests the withdrawal of all pending rejections of the claims.

Status of Claims

Claims 1-20 were previously pending. Applicant herein amends independent claims 1 and 16 to include what Applicant understands to be allowable features of dependent claims 2 and 17, respectively. In particular, Applicant herein amends independent claims 1 and 16 to recite that, *inter alia*, the base portion comprises a feedthrough device, and that the feedthrough device provides the vertical MPD mounting surface. Independent claim 16 was further amended to clarify that the multi-channel optical transceiver comprises, *inter alia*, a multi-channel receiver optical subassembly to overcome a rejection under 35 U.S.C. 112, as discussed below. Claims 2 and 17 were amended for consistency. Claim 20 was amended to correct a minor dependency issue. Dependent claim 11 was cancelled herein without prejudice or disclaimer. No new claims are presented herein. Accordingly, claims 1-10 and 12-20 remain pending for examination with claims 1, 12 and 16 being independent claims.

Allowed Claims & Allowable Subject Matter

Applicant notes with appreciation the Examiner's acknowledgement of allowed claims 12-15, and the indication of allowable subject matter in claims 2-10 and 17-19. *See Office Action dated January 24, 2020; pages 6-9.*

Rejections under 35 U.S.C. § 112

Dependent claim 11 was rejected under 35 U.S.C. 112 as allegedly being indefinite. In particular, Page 2 of the Office Action asserts that: "[t]he claim 11 depends from claim 1 and claim 11 recites a multi-channel transceiver arrangement, however claim 1 does not provide the required claim structure to obtain a multi-channel arrangement because claim 1 pertains to a first LD and a first MPD and does not recite any structural relationship for having four different channels as required by claim 11."

As an initial matter, Applicant respectfully notes that independent claim 1 comprises features such as a first LD and a first MPD, but nothing in independent claim 1 *requires* only these features. Furthermore, dependent claim 11 properly narrows claim 1 to require that the TOSA

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module of claim 1 is implemented within a multi-channel transceiver capable of sending and receiving at least four different channel wavelengths.

Without conceding as to the merits of this rejection, Applicant herein cancels dependent claim 11 merely to advance prosecution. Accordingly, the rejection of claim 11 appears moot and Applicant respectfully requests withdrawal of the rejection.

Independent claim 16 was rejected under 35 U.S.C. 112 for allegedly being indefinite. Page 3 of the Office Action asserts: “The preamble of claim 16 recites a multi-channel transceiver, however no structure has been recited to obtain a multi-channel arrangement and no structure has been recited to receive signals as implied by reciting a transceiver.”

As an initial matter, Applicant notes that the Office appears to have interpreted the preamble limitations reciting “a multi-channel optical transceiver module” as being structural limitations within the claim. However, the Office Action did not articulate a basis for asserting the preamble language of independent claim 16 amounts to structural limitations. *See e.g., MPEP 2111.02(I)*.

Even assuming, *in arguendo*, the Office asserts the preamble language amounts to structural limitations, Applicant notes that one of ordinary skill in the art would recognize the structure of a multi-channel optical transceiver, particularly in view of Applicant’s disclosure. Applicant is also unclear how the preamble language of independent claim 16 can be identified as *structural* by the Office Action and simultaneously support the Office Action’s position that “the claim provides *no structure* for a multi-channel transceiver. . . .” *See Office Action dated January 24, 2020; page 3*.

In any event, and without conceding the merits of this rejection, Applicant herein amends independent claim 16 to include, *inter alia*, a multi-channel ROSA arrangement. Support for this amendment can be found at, paras. 0026, 0030-0032, and FIGs. 2-3 of Applicant’s originally filed disclosure.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejection of claim 16, and the claims dependent therefrom, under 35 U.S.C. 112.

Rejections under 35 U.S.C. § 102

Claims 1 and 11 were rejected under 35 U.S.C. § 102 as being unpatentable over U.S. Pat. Pub. No. 2018/0138657 (Mura). Applicant respectfully requests reconsideration in view of the following remarks.

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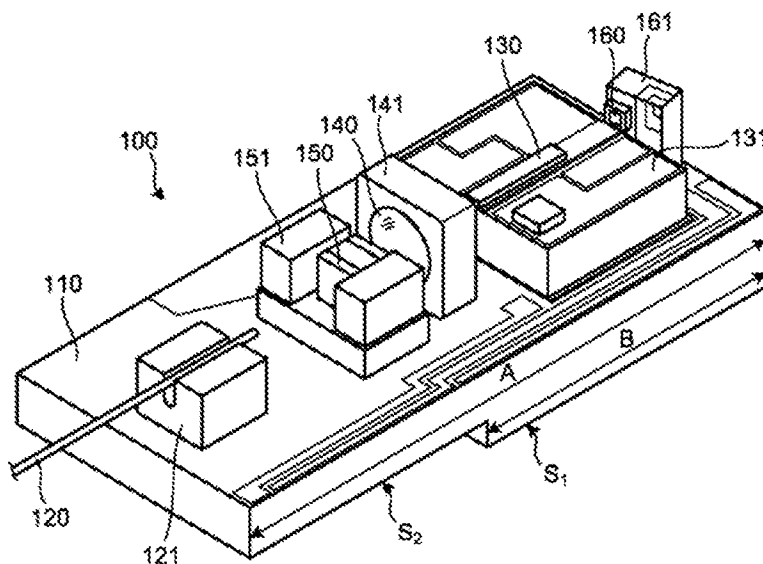
Dependent claim 11 was cancelled herein without prejudice or disclaimer and this rejection now appears moot.

Independent claim 1 has been amended to include certain features of dependent claim 2 understood to be allowable over the art of record. In particular, Applicant has amended claim 1 to recite, *inter alia*, that the base portion comprises a feedthrough device, with the feedthrough device providing the vertical MPD mounting surface.

In contrast, Mura discloses that the photodiode 160 mounts to a base 110 by way of photodiode holder 161. FIG. 2 of Mura is reproduced below for reference. In Mura, the base 110 is configured to be disposed within housing 200, *see e.g., Mura; FIGs. 1 and 6*, but nothing in Mura teaches that base 110 is a feedthrough device.

The Office Action appears to agree with Applicant's understanding that Mura fails to teach or make obvious such a feature based on allowed independent claim 12 being generally directed to a method that includes "mounting at least one MPD to a vertical MPD mounting surface provided by a feedthrough device."

FIG.2



For at least these reasons, Mura fails to identically disclose each and every feature of independent claim 1.

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Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejections of independent claim 1 under 35 U.S.C. 102.

Rejections under 35 U.S.C. § 103

Claim 16 was rejected under 35 U.S.C. 103 as being unpatentable over Mura in view of U.S. Pat. Pub. No. 2004/0163836 (Kumar). Applicant respectfully requests reconsideration in view of the following remarks.

Claim 16 was amended to include the features of dependent claim 17 understood by Applicant to be allowable. Thus, claim 16 recites features similar to those of independent claim 1 and now recites, *inter alia*, that the base portion comprises a feedthrough device, and that the feedthrough device provides the vertical MPD mounting surface. As discussed above, nothing in Mura teaches or makes obvious such a feature.

Kumar was cited to by the Office Action in effort to teach the printed circuit board assembly (PCBA) recited in independent claim 16. *See Office Action dated January 24, 2020; page 6.* Applicant does not concede the merits of the Office Action's assertions regarding the teachings of Kumar, but respectfully notes that nothing in Kumar remedies the deficiencies of Mura noted above.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejections under 35 U.S.C. § 103.

Having dealt with all the objections raised by the Examiner, it is respectfully submitted that the present application, as amended, is in condition for allowance. Thus, early allowance is earnestly solicited.

If the Examiner desires personal contact for further disposition of this case, the Examiner is invited to call the undersigned Attorney at 603.668.6560.

In the event there are any fees due, please charge them to our Deposit Account No. 50-1705 (Ref: PAT266-002US).

Respectfully submitted,

By: /Kenneth M. Thompson/

Date: April 14, 2020

Kenneth M. Thompson
Reg. No. 72,001

Electronic Acknowledgement Receipt

EFS ID:	39262029
Application Number:	16268765
International Application Number:	
Confirmation Number:	3070
Title of Invention:	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES
First Named Inventor/Applicant Name:	Kai-Sheng LIN
Customer Number:	27543
Filer:	Kenneth M. Thompson/April Davis
Filer Authorized By:	Kenneth M. Thompson
Attorney Docket Number:	PAT266-002US
Receipt Date:	24-APR-2020
Filing Date:	06-FEB-2019
Time Stamp:	16:54:04
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		PAT266_002US_Amendment_a sfiled.pdf	276168 8b709673c676e9674bbf3d53eef0eef1f50f0717	yes	10

Multipart Description/PDF files in .zip description			
Document Description	Start	End	
Amendment/Req. Reconsideration-After Non-Final Reject	1	1	
Claims	2	6	
Applicant Arguments/Remarks Made in an Amendment	7	10	
Warnings:			
Information:			
Total Files Size (in bytes):		276168	
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>			

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 16/268,765		Filing Date 02/06/2019		☐ To be Mailed	
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO									
APPLICATION AS FILED - PART I									
		(Column 1)	(Column 2)						
FOR		NUMBER FILED	NUMBER EXTRA		RATE (\$)		FEE (\$)		
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A	N/A		N/A				
☐ SEARCH FEE (37 CFR 1.16(k), (l), or (m))		N/A	N/A		N/A				
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A	N/A		N/A				
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 = *		x \$100 =					
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 = *		x \$460 =					
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).							
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))									
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL				
APPLICATION AS AMENDED - PART II									
		(Column 1)		(Column 2)	(Column 3)				
AMENDMENT	04/24/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	* 19	Minus	** 20	= 0	x \$100 =		0	
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0	x \$460 =		0	
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE		0	
		(Column 1)		(Column 2)	(Column 3)				
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	*	Minus	**	=	x \$0 =			
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x \$0 =			
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE			
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.						LIE			
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".						/RAMONA D WILSON/			
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".									
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.									

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/268,765	02/06/2019	Kai-Sheng LIN	PAT266-002US	3070
27543	7590	01/24/2020	EXAMINER	
APPLIED OPTOELECTRONICS, INC.			RODRIGUEZ, ARMANDO	
13115 JESS PIRTLE BLVD.				
SUGAR LAND, TX 77478				
			ART UNIT	PAPER NUMBER
			2828	
			NOTIFICATION DATE	DELIVERY MODE
			01/24/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docketing@gtpp.com
kcarroll@gtpp.com
kinsella@ao-inc.com

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):

(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 11, 16-19 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Regarding claim 11.

The claim 11 depends from claim 1 and claim 11 recites a multi-channel transceiver arrangement, however claim 1 does not provide the required claim structure to obtain a multi-channel arrangement because claim 1 pertains to a first LD and a first MPD and does not recite any structural relationship for having four different channels as required by claim 11. Furthermore, the office also interprets claim 11 as claiming a transceiver which transmit and receive signals no structure has been recited in claims 1 and 11 to receive signals.

Since claims 1 and 11 lack the required structure for a multi-channel transceiver a proper search of claim 11 cannot be completed and claim 11 will be examined as having a first laser diode and a first photodiode as claimed in claim 1.

Regarding claims 16-19.

The preamble of claim 16 recites a multi-channel transceiver, however no structure has been recited to obtain a multi-channel arrangement and no structure has been recited to receive signals as implied by reciting a transceiver. Thereby, since the claim provides no structure for a multi-channel transceiver the claim will be examined as the module having a first laser diode and a first photodiode.

Claims 17-19 depend from claim 16.

Claim Rejections - 35 USC § 102

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

Claim(s) 1 and 11 is/are rejected under 35 U.S.C. 102(a)(2) as being anticipated by Mura et al US 2018/0138657.

Regarding claims 1 and 11 (see 112(b) rejection above for claim 11).

Mura et al illustrates in figures 1-3 a transmitter optical subassembly (TOSA) module, the TOSA module comprising:

a laser diode (LD) mounting surface (fig. 2, 131 paragraph [00221]); at least a first LD (fig. 2, 130 paragraph [0020] and [0003]) disposed on the LD mounting surface (131), the first LD (130) having a back-side emission surface for emitting a portion of optical power along a first optical path (paragraph [0022] output to the posterior of the semiconductor laser); a base portion providing a vertical MPD mounting surface (fig. 2, 161 paragraph [0021]); and a first MPD (fig. 2, 160 paragraph [0021]) disposed on the vertical MPD mounting surface (161), the first MPD (160) having a light receiving region optically aligned with the first LD (130) via the first optical path based at least in part on the vertical MPD mounting surface (161) extending substantially transverse relative to the LD mounting surface (131) such that the first optical path intersects with the light receiving region of the first MPD (160).

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have

been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claim 16 is/are rejected under 35 U.S.C. 103 as being unpatentable over Mura et al US 2018/0138657 in view of Kumar et al US 2004/0163836.

Regarding claim 16.

Mura et al illustrates in figures 1-3 a multi-channel optical transceiver module (see 112(b) rejection regarding the preamble) comprising:

a transmitter optical subassembly (TOSA) module (figs. 1-3), the TOSA module comprising:

a laser diode (LD) mounting surface (fig. 2, 131 paragraph [00221]); at least a first LD (fig. 2, 130 paragraph [0020] and [0003]) disposed on the LD mounting surface (131), the first LD (130) having a back-side emission surface for emitting a portion of optical power along a first optical path (paragraph [0022] output to the posterior of the semiconductor laser); a base portion providing a vertical MPD mounting surface (fig. 2, 161 paragraph [0021]); and a first MPD (fig. 2, 160 paragraph [0021]) disposed on the vertical MPD mounting surface (161), the first MPD (160) having a light receiving region

optically aligned with the first LD (130) via the first optical path based at least in part on the vertical MPD mounting surface (161) extending substantially transverse relative to the LD mounting surface (131) such that the first optical path intersects with the light receiving region of the first MPD (160).

Mura et al does not disclose a printed circuit board assembly (PCBA);

a transmitter optical subassembly (TOSA) arrangement coupled to the PCBA.

Kumar et al illustrates in figure 4E a transmitter module (fig. 4E, 700) coupled a printed circuit board assembly (PCBA) (fig. 4E PCB).

Therefore, it would have been obvious to a person of ordinary skill in the art before the effective filing date of the invention to combine the well-known teachings of Kumar et al with the device of Mura et al because it will allow to connect different electronic components into a working circuit.

Allowable Subject Matter

Claims 12-15 and 20 are allowed.

The following is an examiner's statement of reasons for allowance:

Regarding claims 12-15 and 20.

None of the searched prior arts alone or in combination discloses the claimed invention having the recited method steps of independent claim 12 including the step of inserting the feedthrough device into a cavity of the TOSA housing to bring the plurality of conductive traces into close proximity with the LDs in the TOSA, wherein inserting the feedthrough device into the cavity causes each of the at least one MPDs mounted to the vertical MPD mounting surface to optically couple with a back-side emission surface of each corresponding LD.

Claims 13-15 and 20 depend from claim 12.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Claims 2-10, 17-19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 2.

None of the searched prior arts alone or in combination discloses the claimed housing having a plurality of sidewalls that define a cavity, the LD mounting surface being disposed in the cavity; and a feedthrough device defined at least in part by the base, the feedthrough device configured to at least partially be disposed in the cavity of the housing, and wherein a first end of the feedthrough device provides an electrical coupling region to electrically couple to an optical module substrate to receive a radio frequency (RF) driving signal to drive the first LD, and a second end of the feedthrough device defines the vertical MPD mounting surface, the vertical MPD mounting surface being disposed in the cavity.

Claims 3 and 4 depend from claim 2.

Regarding claim 5.

None of the searched prior arts alone or in combination discloses the claimed plurality of transmit (TX) radio frequency (RF) traces, the TX RF traces being disposed on a surface of the base that extends away from the vertical mounting surface along a direction that is substantially parallel with the LD mounting surface.

Claim 6 depends from claim 5.

Regarding claim 7.

None of the searched prior arts alone or in combination discloses the claimed second LD disposed on the LD mounting surface and a second MPD disposed on the vertical MPD mounting surface, the second LD being configured to emit an associated channel wavelength different from that of the first LD, and wherein the second LD and second MPD are optically aligned via a second optical path such that the second optical path extends from a back-side emission surface of the second LD and intersects with a light receiving region of the second MPD.

Claims 8-10 depend from claim 7.

Regarding claim 17.

None of the searched prior arts alone or in combination discloses the claimed TOSA housing having a plurality of sidewalls that define a cavity, the LD mounting surface being disposed in the cavity; and a feedthrough device defined at least in part by the base, the feedthrough device configured to at least partially be disposed in the cavity of the TOSA housing, and wherein a first end of the feedthrough device provides an electrical coupling region to electrically couple to an optical module substrate to receive a radio frequency (RF) driving signal to drive the first LD, and a second end of

the feedthrough device defines the vertical MPD mounting surface, the vertical MPD mounting surface being disposed in the cavity of the TOSA housing.

Claims 18 and 19 depend from claim 17.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ARMANDO RODRIGUEZ whose telephone number is (571)272-1952. The examiner can normally be reached on M-F 9:00AM-5:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, JESSICA MANNO can be reached on 571-272-2339. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ARMANDO RODRIGUEZ/
Primary Examiner, Art Unit 2828

<i>Notice of References Cited</i>	Application/Control No. 16/268,765		Applicant(s)/Patent Under Reexamination LIN et al.	
	Examiner ARMANDO RODRIGUEZ		Art Unit 2828	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20180138657-A1	05-2018	MIURA; Masakazu	G02B6/32	1/1
*	B	US-20040163836-A1	08-2004	Kumar, Dev E.	H01S5/02212	174/50
	C					
	D					
	E					
	F					
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	H					
	I					
	J					
	K					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

<i>Search Notes</i> 	Application/Control No. 16/268,765	Applicant(s)/Patent Under Reexamination LIN et al.
	Examiner ARMANDO RODRIGUEZ	Art Unit 2828

CPC - Searched*		
Symbol	Date	Examiner
H01S 5/02236, 0014, 02415, 4012, 4087, 02208, 02212, 02415	01/16/2020	AR

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
EAST TERM SEARCH	01/16/2020	AR
INVENTOR NAME SEARCH	01/16/2020	AR
ASSIGNEE SEARCH	01/16/2020	AR

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
CLAIM SEARCH		01/16/2020	AR

/ARMANDO RODRIGUEZ/ Primary Examiner, Art Unit 2828	
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	110	tosa and laser near3 diode and (mpd or (monitor near3 photodiode)) and hermetic\$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 13:27
S2	2	tosa and laser near3 diode near3 back near3 emission and (mpd or (monitor near3 photodiode)) and hermetic\$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 13:28
S3	191	tosa and laser near3 diode and (mpd or (monitor near3 photodiode)) and tec	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 13:57
S4	142	S3 not S1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 13:57
S5	436	tosa and laser near3 diode and (mpd or (monitor near3 photodiode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 15:28
S6	1598	H01S5/02236.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:02
S7	75	S6 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:02
S8	2304	H01S5/0014.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:21
S9	214	S8 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:21
S10	3664	H01S5/02415.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:55
S11	492	S10 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/16 18:56
S12	4421	H01S5/4012.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 10:12

S13	207	S12 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 10:12
S14	5816	H01S5/4087.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 11:40
S15	314	S14 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 11:41
S16	1710	H01S5/02208.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 12:16
S17	130	S16 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 12:17
S18	3593	H01S5/02212.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:08
S19	404	S18 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:08
S20	741	H01S5/0222.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:30
S21	31	S20 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:30
S22	2569	H01S5/02469.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:33
S23	3664	H01S5/02415.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:33
S24	492	S23 and laser near3 diode and photodiode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/17 13:33
S25	217	"Applied Optoelectronics".as.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/20 08:50
S26	49	S25 and tosa and laser near3 diode and (mpd or (monitor near3 photodiode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/20 08:51
S27	553	((kai near3 sheng near3 lin) or (hsiu near3 che near3 wang) or (kevin near3 liu)).in.	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2020/01/20 09:17

			EPO; JPO			
S28	35	S27 and tosa and laser near3 diode and (mpd or (monitor near3 photodiode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO	OR	ON	2020/01/20 09:18

1 / 20 / 2020 2:42:42 PM

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Bibliographic Data

Application No: 16/268,765

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No

☐ Met After Allowance

Verified and Acknowledged:

/ARMANDO RODRIGUEZ/

Examiner's Signature

Initials

Title:

TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT
WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
02/06/2019	372	2828	PAT266-002US
RULE			

APPLICANTS

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Hsiu-Che WANG Rosenberg, TX, UNITED STATES

Kevin LIU Houston, TX, UNITED STATES

CONTINUING DATA

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

03/06/2019

STATE OR COUNTRY

UNITED STATES

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SUGAR LAND, TX 77478

UNITED STATES

FILING FEE RECEIVED

\$1,720



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
16/268,765	02/06/2019	2636	1720	PAT266-002US	20	3

CONFIRMATION NO. 3070

FILING RECEIPT

27543
APPLIED OPTOELECTRONICS, INC.
13115 JESS PIRTLE BLVD.
SUGAR LAND, TX 77478



Date Mailed: 03/08/2019

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Inventor(s)

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Kevin LIU, Houston, TX;

Applicant(s)

Applied Optoelectronics, Inc., Sugar Land, TX;

Power of Attorney: The patent practitioners associated with Customer Number 27543

Domestic Applications for which benefit is claimed - None.

A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

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Permission to Access Application via Priority Document Exchange: Yes

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If Required, Foreign Filing License Granted: 03/06/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/268,765**

Projected Publication Date: 08/06/2020

Non-Publication Request: No

Early Publication Request: No

Title

TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED
MONITOR PHOTODIODES

Preliminary Class

398

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 16/268,765	
APPLICATION AS FILED - PART I							
(Column 1)		(Column 2)		SMALL ENTITY		OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(j))	20	minus 20 = *			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 = *				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
			TOTAL			TOTAL	1720
* If the difference in column 1 is less than zero, enter "0" in column 2.							
APPLICATION AS AMENDED - PART II							
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY	
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)
	Total (37 CFR 1.16(i))	*	Minus **	=	x =	OR	x =
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =	OR	x =
	Application Size Fee (37 CFR 1.16(s))					OR	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					OR	
			TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY	
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)
	Total (37 CFR 1.16(i))	*	Minus **	=	x =	OR	x =
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =	OR	x =
	Application Size Fee (37 CFR 1.16(s))					OR	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					OR	
			TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.							

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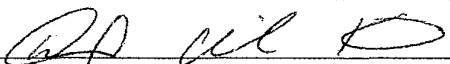
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Applied Optoelectronics, Inc.	
Applicant Name	
13115 Jess Pirtle Blvd., Sugar Land, TX 77478	
Applicant Address	
Signature 	Date 9/24/2012
Name and Title (of individual signing on behalf of assignee or obligated assignee)	
David Kuo, Assistant General Counsel	

TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

TECHNICAL FIELD

[0001] The present disclosure relates to optical communications, and more particularly, to a transmitter optical subassembly (TOSA) arrangement having vertically-mounted monitor photodiodes to reduce housing dimensions and improve radio frequency (RF) drive signal quality.

BACKGROUND INFORMATION

[0002] Optical transceivers are used to transmit and receive optical signals for various applications including, without limitation, internet data center, cable TV broadband, and fiber to the home (FTTH) applications. Optical transceivers provide higher speeds and bandwidth over longer distances, for example, as compared to transmission over copper cables. The desire to provide higher transmit/receive speeds in increasingly space-constrained optical transceiver modules has presented challenges, for example, with respect to thermal management, insertion loss, RF driving signal quality and manufacturing yield.

[0003] Optical transceiver modules generally include one or more transmitter optical subassemblies (TOSAs) for transmitting optical signals. TOSAs can include one or more lasers to emit one or more channel wavelengths and associated circuitry for driving the lasers. Some optical applications, such as long-distance communication, can require TOSAs to include hermetically-sealed housings with arrayed waveguide gratings, temperature control devices, laser packages and associated circuitry disposed therein to reduce loss and ensure optical performance. However, the inclusion of hermetically-sealed components increases manufacturing complexity, cost, and raises numerous non-trivial challenges within space-constrained housings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] These and other features and advantages will be better understood by reading the following detailed description, taken together with the drawings wherein:

[0005] FIG. 1 is a block diagram of a multi-channel optical transceiver module, consistent with embodiments of the present disclosure.

[0006] FIG. 2 is a perspective view of an optical transceiver module consistent with embodiments of the present disclosure.

[0007] FIG. 3 is a side view of the optical transceiver module of FIG. 2 in accordance with an embodiment of the present disclosure.

[0008] FIGs. 4-5 collectively show an example TOSA arrangement suitable for use in the optical transceiver module of FIGs. 2-3, in accordance with an embodiment of the present disclosure.

[0009] FIG. 6 is a top view of the example TOSA arrangement of FIGs. 4-5, consistent with embodiments of the present disclosure.

[0010] FIG. 7 shows an enlarged portion of a cavity of the example TOSA arrangement of FIGs. 4-6, in accordance with an embodiment of the present disclosure.

[0011] FIG. 8A is a side view of the example TOSA arrangement of FIGs. 4-7, in accordance with an embodiment of the present disclosure.

[0012] FIG. 8B is a cross-sectional view of the example TOSA arrangement of FIG. 5 taken along line 8B-8B, in accordance with an embodiment of the present disclosure.

[0013] FIG. 9 is another example TOSA arrangement suitable for use in the optical transceiver module of FIGs. 2-3, in accordance with an embodiment of the present disclosure.

[0014] FIG. 10 shows an existing approach to registering optical power of a laser arrangement.

DETAILED DESCRIPTION

[0015] As discussed above, some TOSAs can reach optical transmission distances of up to 10km or more. Such TOSAs may be suitable for use in C form-factor pluggable (CFP), CFP2, CFP4 and quad small form-factor pluggable (QSFP) applications. In general, such TOSAs include a hermetic-sealed package (or housing) with an LC receptacle (or other suitable port) for optical coupling. The hermetic-sealed package can house laser packages, e.g., electro-absorption modulator integrated lasers (EMLs), power monitors photodiodes (PDs), thermoelectric coolers (TECs), an optical multiplexer such as an arrayed waveguide grating (AWG) for multiplexing multiple channel wavelengths, and electrical interconnects such as flexible printed circuit boards, and optical interconnects such as fiber stubs. Hermetic-sealed packages can include cavities specifically designed to house such components in a manner that optimizes the space constraints

and promotes thermal communication. However, manufacturing hermetic-sealed packages with the dimensions necessary to fit the components of the light engine increases manufacturing cost and complexity.

[0016] One component in such TOSAs that can result in increased cost and complexity is monitor photodiodes (MPDs). MPDs can be used to monitor optical power of a corresponding laser diode. However, existing approaches tend to position MPDs behind, in front of, or otherwise adjacent an associated laser diode. In some cases, MPDs are mounted to the same substrate as the associated LD. For example, FIG. 10 shows one example of laser arrangement 1000 whereby a sidewall of a TOSA housing 1004 supports a substrate 1002 (or submount), and the substrate 1002 and/or the surface of the TOSA housing 1004 supports LD 1008 and the MPD 1006. One position utilized for registering optical power from an LD by an MPD 1006 is directly behind the LD 1008 to receive a small portion of optical power 1011 emitted by the LD 1008 backwards away from a transmit (TX) waveguide, e.g., an optical fiber. Another position includes mounting the MPD 1006 below or otherwise in front of the LD 1008 to directly receive the optical power 1010 emitted by the LD 1008.

[0017] In either case, the TOSA housing 1004 must be dimensioned to accommodate the position of the MPD 1006, with the result being an overall increase in housing length along dimension D. This results in two significant challenges for TOSA designs. First, the position of the MPD, e.g., behind the LD 1008, can require that interconnect circuitry such as wire bonds 1014 that extend from the laser diode driver (LDD) 1012 to the LD 1008 must be lengthened to route over/around the MPD 1006. Extending and routing the wire bonds 1014 in this fashion can result in time-of-flight (TOF) delays and impedance matching issues as well as worse RF performance. Second, increasing the overall length can increase the overall volume of the TOSA housing cavity and the complexity in the manufacture of the TOSA. In scenarios where hermetically-sealed housings are utilized, this can result in a significantly higher cost and time per unit to manufacture, which can ultimately reduce yield.

[0018] Thus, the present disclosure is generally directed to a multi-channel TOSA with vertically-mounted MPDs to reduce TOSA housing dimensions and improve RF driving signal quality. In more detail, a TOSA housing consistent with the present disclosure includes at least one vertical MPD mounting surface that extends substantially transverse relative to a LD mounting surface, with the result being that a MPD coupled to the vertical MPD mounting

surface gets positioned above an associated LD coupled to the LD mounting surface. The vertically-mounted MPD thus makes regions adjacent an LD that would otherwise be utilized to mount an MPD available for patterning of conductive RF traces to provide an RF driving signal to the LD. The conductive RF traces may therefore extend below the vertically-mounted MPD to a location that is proximate the LD to allow for relatively short wire bonds therebetween.

[0019] In a specific example embodiment, the vertical MPD mounting surface may be provided at least in part by a feedthrough device of the TOSA housing. The feedthrough device can be configured to be at least partially disposed in a hermetically-sealed cavity of the TOSA housing to provide electrical connectivity to optical components therein. The feedthrough device may also provide a conductive trace mounting surface that extends substantially transverse relative to the vertical MPD mounting surface for purposes of patterning the above-discussed conductive RF traces. Accordingly, an MPD may be securely mounted to the feedthrough device prior to insertion of the feedthrough device into a TOSA housing. Likewise, the conductive RF traces and other associated circuitry (e.g., filtering capacitors, conductive direct current (DC) traces, and so on) may be patterned/disposed when the feedthrough device is outside of the TOSA housing. Thus, insertion of the feedthrough device within the TOSA housing can result in the vertically-mounted MPD being passively optically aligned with an associated LD, and the conductive RF traces being brought within a predefined distance of the LD for electrical coupling purposes via, for instance, wire bonds.

[0020] The present disclosure therefore provides numerous advantageous over other TOSA approaches. For example, manufacturing of a TOSA may be conducted in a modular fashion whereby a feedthrough device and TOSA housing may be manufactured and configured separate from each other. For instance, components such as conductive traces and MPDs may be mounted/coupled to the feedthrough device in a parallel manufacturing process to allow for the TOSA housing and associated components to be completed apart from the feedthrough device, with the net result decreasing production time, reducing errors, and ultimately increasing yield. In addition, a TOSA housing with vertically-mounted MPDs consistent with the present disclosure advantageously reduces overall housing dimensions while allowing for LDs to be disposed in close proximity of conductive traces for electrical coupling purposes. RF signal quality may therefore be enhanced via relatively short wire bonds, for example, while simultaneously reducing cost, time-per-unit, and complexity to manufacture each TOSA.

[0021] As used herein, the terms hermetic-sealed and hermetically-sealed may be used interchangeably and refer to a housing that releases a maximum of about 5×10^{-8} cc/sec of filler gas. The filler gas may comprise an inert gas such as nitrogen, helium, argon, krypton, xenon, or various mixtures thereof, including a nitrogen-helium mix, a neon-helium mix, a krypton-helium mix, or a xenon-helium mix.

[0022] As used herein, “channel wavelengths” refer to the wavelengths associated with optical channels and may include a specified wavelength band around a center wavelength. In one example, the channel wavelengths may be defined by an International Telecommunication (ITU) standard such as the ITU-T dense wavelength division multiplexing (DWDM) grid. This disclosure is equally applicable to coarse wavelength division multiplexing (CWDM). In one specific example embodiment, the channel wavelengths are implemented in accordance with local area network (LAN) wavelength division multiplexing (WDM), which may also be referred to as LWDM.

[0023] The term “coupled” as used herein refers to any connection, coupling, link or the like and “optically coupled” refers to coupling such that light from one element is imparted to another element. Such “coupled” devices are not necessarily directly connected to one another and may be separated by intermediate components or devices that may manipulate or modify such signals. On the other hand, the term “direct optical coupling” refers to an optical coupling via an optical path between two elements that does not include such intermediate components or devices, e.g., a mirror, waveguide, and so on, or bends/turns along the optical path between two elements.

[0024] The term substantially, as generally referred to herein, refers to a degree of precision within acceptable tolerance that accounts for and reflects minor real-world variation due to material composition, material defects, and/or limitations/peculiarities in manufacturing processes. Such variation may therefore be said to achieve largely, but not necessarily wholly, the stated characteristic. To provide one non-limiting numerical example to quantify “substantially,” minor variation may cause a deviation of up to and including $\pm 5\%$ from a particular stated quality/characteristic unless otherwise provided by the present disclosure.

[0025] Referring to the Figures, FIG. 1, an optical transceiver 100, consistent with embodiments of the present disclosure, is shown and described. In this embodiment, the optical transceiver 100 includes a multi-channel TOSA arrangement and a multi-channel ROSA arrangement 106 coupled to a substrate 102, which may also be referred to as an optical module substrate. The

substrate 102 may comprise, for example, a printed circuit board (PCB) or PCB assembly (PCBA). The substrate 102 may be configured to be “pluggable” for insertion into an optional transceiver cage 109.

[0026] In the embodiment shown, the optical transceiver 100 transmits and receives four (4) channels using four different channel wavelengths (λ_1 , λ_2 , λ_3 , λ_4) via the multi-channel TOSA arrangement 104 and the multi-channel ROSA arrangement 106, respectively, and may be capable of transmission rates of at least about 25 Gbps per channel. In one example, the channel wavelengths λ_1 , λ_2 , λ_3 , λ_4 may be 1270 nm, 1290 nm, 1310 nm, and 1330 nm, respectively. Other channel wavelengths are within the scope of this disclosure including those associated with local area network (LAN) wavelength division multiplexing (WDM). The optical transceiver 100 may also be capable of transmission distances of 2 km to at least about 10 km. The optical transceiver 100 may be used, for example, in internet data center applications or fiber to the home (FTTH) applications. Although the following examples and embodiments show and describe a 4-channel optical transceiver, this disclosure is not limited in this regard. For example, the present disclosure is equally applicable to 2, 6, or 8-channel configurations.

[0027] In more detail, the multi-channel TOSA arrangement 104 includes a TOSA housing 114 with a plurality of sidewalls that define an optical component cavity 220, which may be referred to as simply a cavity (See FIG. 4). The cavity 220 includes a plurality of laser arrangements 110 disposed therein, which will be discussed in more detail below, with each laser arrangement of the plurality of laser arrangements 110 being configured to transmit optical signals having different associated channel wavelengths. Each laser arrangement may include passive and/or active optical components such as a laser diode (LD), monitor photodiode (MPD), laser diode driver (LDD), and so on. Additional components comprising each laser arrangement include filters, focusing lenses, filtering capacitors, and so on.

[0028] To drive the plurality of laser arrangements 110, the optical transceiver 100 includes a transmit connecting circuit 112 to provide electrical connections to the plurality of laser arrangements 110 within the housing 114. The transmit connecting circuit 112 may be configured to receive driving signals (e.g., TX_D1 to TX_D4) from, for example, circuitry within the optical transceiver cage 109. As shown, the housing 114 may be hermetically sealed to prevent ingress of foreign material, e.g., dust and debris. Therefore, a plurality of transmit (TX) traces 117 (or electrically conductive paths) are patterned on at least one surface of the substrate

102 and are electrically coupled with a feedthrough device 116 of the TOSA housing 114 to bring the transmit connecting circuit 112 into electrical communication with the plurality of laser arrangements 110, and thus, electrically interconnect the transmit connecting circuit 112 with the multi-channel TOSA arrangement 104. The feedthrough device 116 may comprise, for instance, ceramic, metal, or any other suitable material.

[0029] In operation, the multi-channel TOSA arrangement 104 may then receive driving signals (e.g., TX_D1 to TX_D4), and in response thereto, generates and launches multiplexed channel wavelengths on to an output waveguide 120 such as a transmit optical fiber. The generated multiplexed channel wavelengths may be combined based on a multiplexing device 124 such as an arrayed waveguide grating (AWG) that is configured to receive emitted channel wavelengths 126 from the plurality of laser assemblies 110 and output a signal carrying the multiplexed channel wavelengths on to the output waveguide 120 by way of optical fiber receptacle 122.

[0030] Continuing on, the multi-channel ROSA arrangement 106 includes a demultiplexing device 124, e.g., an arrayed waveguide grating (AWG), a photodiode (PD) array 128, and an amplification circuitry 130, e.g., a transimpedance amplifier (TIA). An input port of the demultiplexing device 124 may be optically coupled with a receive waveguide 134, e.g., an optical fiber, by way of an optical fiber receptacle 136. An output port of the demultiplexing device 124 may be configured to output separated channel wavelengths on to the PD array 128. The PD array 128 may then output proportional electrical signals to the TIA 130, which then may be amplified and otherwise conditioned. The PD array 128 and the transimpedance amplifier 136 detect and convert optical signals received from the receive waveguide 134, e.g., an optical fiber, into electrical data signals (RX_D1 to RX_D4) that are output via the receive connecting circuit 108. In operation, the PD array 128 may then output electrical signals carrying a representation of the received channel wavelengths to a receive connecting circuit 132 by way of conductive traces 119 (which may be referred to as conductive paths).

[0031] Referring now to FIGs. 2-3, an example optical transceiver module 200 is shown consistent with an embodiment of the present disclosure. The optical transceiver module 200 may be implemented as the optical transceiver 100 of FIG. 1, the discussion of which is equally applicable to FIGs. 2-3 and will not be repeated for purposes of brevity. As shown, the optical transceiver module 200 includes a substrate 202 that extends from a first end 252 to a second end 254 along a longitudinal axis 250. The first end 252 may electrically couple to a transceiver cage

to receive driving signals, e.g., TX_D1 to TX_D4, and therefore, may be referred to as an electrical coupling end. On the other hand, the second end 254 includes a multi-channel TOSA arrangement 204 and a multi-channel ROSA arrangement 206 for sending and receiving channel wavelengths, respectively, and therefore may be referred to as an optical coupling end.

[0032] In more detail, the substrate includes at least a first mounting surface 256 for mounting of optical components, patterning of conductive traces (e.g., conductive traces 117, 119). Disposed adjacent the first end 252, the substrate 202 includes a plurality of pads/terminals for electrically communicating with, for instance, associated circuitry in a transceiver cage. The substrate 202 includes a multi-channel TOSA arrangement 204 and multi-channel ROSA arrangement 206 disposed adjacent the second end. The multi-channel ROSA arrangement includes amplification circuitry 230, a PD array 228, and a demultiplexing device 224 disposed thereon. An input port 235 of the demultiplexing device 224 may be coupled to an optical coupling receptacle 236 by way of a receive intermediate fiber 268. Accordingly, the demultiplexing device 224 can receive a multiplexed signal 264 from a receive waveguide, e.g., the receive waveguide 134 of FIG. 1. An output port of the demultiplexing device 224 may be optically aligned with the PD array 228 and output separated channel wavelengths thereon. Electrical signals representative of the separated channel wavelengths may then be amplified/filtered by the amplification circuitry before being passed to the receive connecting circuit 132.

[0033] As shown, the TOSA housing 214 is defined by a plurality of sidewalls. A first end 258 of the TOSA housing edge mounts to, and electrically couples with, the second end 258 of the substrate 202. A second end 259 of the TOSA housing 214 couples to an optical coupling receptacle 222 by way of a transmit intermediate fiber 269. The first end 258 of the TOSA housing 214 may also be referred to as an electrical coupling end, and the second end 259 may also be referred to as an optical coupling end. In an embodiment, the TOSA housing 214 may be securely attached to the substrate 202 via one or more electrical interconnect devices as discussed and described in greater detail in co-pending U.S. Patent Application. No. 16/116,087 filed on August 29, 2018 and entitled “Transmitter Optical Subassembly with Hermetically-Sealed Light Engine and External Arrayed Waveguide Grating”, the teaching of which are hereby incorporated in their entirety.

[0034] In an embodiment, the TOSA housing 214 of the multi-channel TOSA arrangement 204 may be hermetically sealed, although in other embodiments the housing may not necessarily be

hermetically sealed. Accordingly, the multi-channel TOSA arrangement 204 may also be referred to as a hermetically-sealed light engine that may be particularly well suited for long-distance transmission, e.g., up to and beyond 10km. The TOSA housing 214 can include a feedthrough device 262 at least partially disposed in a cavity of the TOSA housing 214 to allow for electrical interconnection between the substrate 202 and the multi-channel TOSA arrangement 204. The housing 214 may include a longitudinal axis that extends substantially parallel relative to the longitudinal axis 250 of the substrate 202. The housing 214 may comprise, for example, metal, plastic, ceramic, or any other suitable material. The housing 214 may be formed from multiple pieces, or a single piece, of material.

[0035] The housing 214 may further define a laser cavity 220 (FIG. 4) which may be filled with an inert gas to form an inert atmosphere. In one embodiment, the inert atmosphere sealed within the hermetically-sealed container comprises nitrogen, and preferably, 1 atmosphere (ATM) of nitrogen. The inert atmosphere may also be formed from nitrogen, helium, argon, krypton, xenon, or various mixtures thereof, including a nitrogen-helium mix, a neon-helium mix, a krypton-helium mix, or a xenon-helium mix. The inert gas or gas mix included within the hermetically-sealed cavity 220 may be selected for a particular refractive index or other optical property. Gases may also be selected based on their ability to promote thermal insulation. For instance, Helium is known to promote heat transfer may be utilized alone or in addition to others of the aforementioned gases. In any event, the terms hermetic-sealed and hermetically-sealed may be used interchangeably and refers to a housing that releases a maximum of about 5*10⁻⁸cc/sec of filler gas.

[0036] Turning to FIGs. 4-7, an example embodiment of the TOSA housing 214 of the multi-channel TOSA arrangement 204 is shown in isolation. As shown, the housing 214 extends from a first end 452 to a second end 454 along a longitudinal axis 450. A plurality of sidewalls 214-1 to 214-6 define the TOSA housing 214 and a cavity 220 therebetween. Note, the embodiment shown in FIG. 4 omits the sidewall 214-6 (FIG. 2) that forms a cover portion merely for purposes of clarity.

[0037] The feedthrough device 262 at least partially defines the first end 452 of the TOSA housing 214 and includes a plurality of electrical interconnects 464, e.g., bus bars, external to the cavity 220 for mounting to and electrically coupling with the substrate 102. The plurality of electrical interconnects 464 can provide power and radio frequency (RF) driving signals to the

plurality of laser arrangements 210. The feedthrough device 262 further includes at least one mounting surface such as a vertical monitor photodiode (MPD) mounting surface, which will be discussed in greater detail below.

[0038] Following the feedthrough device 262 within the cavity 220, a plurality of laser arrangements 210 are disposed on and are supported by a mounting surface provided at least in part by the sidewall 214-4. A multiplexing device 224 is also disposed on and supported by the mounting surface provided at least by the sidewall 214-4. The multiplexing device 224 includes a plurality of input ports 456, with each input port being optically aligned with an associated laser arrangement of the plurality of laser arrangements 210. The multiplexing device 224 further includes an output port 458 which is shown more clearly in FIG. 6. The output port 458 of the multiplexing device 224 is optically aligned with an aperture 462 defined by the sidewall 214-3 of the TOSA housing 214. The aperture 462 may then transition to a fiber coupling receptacle 462, with the fiber coupling receptacle 462 being configured to receive the intermediate optical fiber 269 (FIG. 2).

[0039] Thus, in operation, the multiplexing device 224 receives channel wavelengths 466 emitted by the plurality of laser assemblies along direction D1 at the plurality of inputs and then outputs a multiplexed signal 468 having each of the emitted channel wavelengths 466 for transmission via an external transmit optical fiber, for example.

[0040] FIG. 7 shows an enlarged perspective view of the cavity 220 of the housing 214 in accordance with an embodiment. As shown, the feedthrough device 262 includes a step/shoulder configuration defined by a first mounting surfacing 702 that extends in parallel with the longitudinal axis 450 of the TOSA housing 214, a second mounting surface 704 that extends parallel with the first mounting surface, and a third mounting surface 706 that adjoins the first and second mounting surfaces 702, 704 and extends substantially transverse to each of the same. Thus, the first, second and third mounting surfaces 702, 704 and 706 provide a multi-tiered or multi-step mounting structure for coupling to optical components. Each of the mounting surfaces of the feedthrough device 262 will now be discussed in turn.

[0041] The first mounting surface 702 includes a first plurality of conductive traces/paths 708 patterned thereon. The first plurality of conductive traces 708 may be configured to provide power from the substrate 202 and to pass data signals from a plurality of MPDs 712 that are mounted to and supported by the third mounting surface. To this end, the first mounting surface

702 may also be referred to as a MPD trace mounting surface/section. The second mounting surface 704 includes a second plurality of conductive traces/paths 711 disposed thereon. The second plurality of conductive traces/paths 711 may be configured to provide power and data signals from the substrate 202 to each of the plurality of lasers arrangements 210. To this end, the second mounting surface 704 may be referred to as a LD trace mounting surface/section.

[0042] Continuing on, the third mounting surface 706 extends substantially transverse relative to the first and second mounting surfaces 702, 704 and adjoins the same, as discussed above. The third mounting surface 706 may be configured to mount and support a plurality of MPDs shown collectively as 712 and individually as 712-1 to 712-4. Each MPD of the plurality of MPDs 712 may be supported by a MPD submount 714, with the MPD submount 714 providing electrical traces for electrically interconnecting MPDs to associated conductive traces of the MPD trace mounting section 708. The MPD submount 714 may be a single piece, e.g., a single PCB or other suitable substrate, or may be multiple pieces. One advantage of a single piece MPD submount 714 is that attachment and alignment of MPDs to the feedthrough device 262 can be simplified as each MPD may be placed on to the MPD submount 714 at predefined positions prior to insertion of the feedthrough device 262 into the cavity 202 of the housing 214. Accordingly, coupling the MPD submount 714 to the feedthrough device 262 optically aligns each of the MPDs disposed thereon without necessarily performing additional alignment steps.

[0043] As further shown, each MPD of the plurality of MPDs 712 includes a light receiving region, e.g., light receiving surface 716-4 of MPD 712-4 shown in FIG. 8B, on an upper/top surface of each chip that is optically aligned with a corresponding laser arrangement of the plurality of laser arrangements 210. This vertical mounting of each MPD allows for a smaller overall footprint for the feedthrough device 262, and by extension, shortens the overall length of the TOSA housing 214. This vertical mounting configuration achieves housing size reduction by freeing the space behind/adjacent each laser arrangement to permit the LD traces of the second mounting surface 704 to extend below the plurality of MPDs 712 and be disposed in close proximity of the plurality of laser assemblies 201. This removal of the MPDs from being behind/adjacent a corresponding laser arrangement also advantageously allows for relatively short electrical interconnection via wire bonding between the LD traces of the second mounting surface 704 and each laser arrangement, which reduces issues such as time of flight (TOF) and impedance mismatching that can ultimately degrade RF signal quality.

[0044] Continuing on, each of the plurality of laser arrangements 210 includes a laser diode supported by a laser submount 213 and optional thermoelectric cooling (TEC) arrangement. For instance, the laser arrangement 210-4 associated with channel 4 (CH4) includes a laser diode 211-4 mounted to and supported by the laser diode submount 213. As shown in the cross-sectional view of FIG. 8B, the laser diode submount 213 is mounted to and is supported by TEC devices 720. In turn, TEC devices 720 are mounted to and supported by a surface provided by sidewall 214-4 of the TOSA housing 214. The laser diode submount may also support thermistors such as thermistor 724-4 (FIG. 7). Following the plurality of laser assemblies 210, each laser arrangement can include a focusing lens e.g., focusing lens 726-4, mounted to and supported by the laser diode submount 713. The laser submount 213 may comprise a single piece, such as shown, or may be formed from multiple pieces.

[0045] Following the plurality of laser arrangements 210, the multiplexing device 224 is mounted to and is supported by a multiplexing submount 720. The input ports 456 of the multiplexing device 224 are optically aligned with the plurality of laser arrangements 210. To this end, a plurality of optical paths 850 extend longitudinally through the cavity 220, with each optical path extending from a corresponding laser diode. A portion of optical power, e.g., 2% or less, gets emitted from a surface opposite the emission face of each LD (also known as a back-side emission surface) and is registered by each MPD, e.g., converted to a proportional electrical current, to form a feedback loop to ensure optical power. Thus, each of the plurality of optical paths 850 also intersects with the vertically mounted MPDs 712, and more particularly, a light receiving region of each corresponding vertically mounted MPDs 712, e.g., light receiving region 716-4.

[0046] During operation, channel wavelengths emitted by each of the plurality of laser assemblies 210 is launched on to a corresponding path of the plurality of optical paths 850, with each of the plurality of optical paths 850 extending substantially parallel relative to each other. As discussed above, a portion of the optical power gets emitted from a surface opposite of the emission surface of each laser diode, which may be referred to as a back-side emission surface, thus launching a portion of optical power towards the MPDs 712. Each light receiving region of the MPDs, e.g., light receiving region 716-4, then registers this portion of optical power for purposes of providing a feedback loop, e.g., by converting optical power to a proportional electrical current. The emitted channel wavelengths then get received via input ports 456 of the

multiplexing device 224. The multiplexing device 224 then combines the received channel wavelengths into a multiplexed optical signal 263 (see FIG. 2). At an output 458 of the multiplexing device 224 the multiplexed signal 263 is output via the aperture on to the intermediate optical fiber 269 (See FIG. 2), and then ultimately to an external transmit optical fiber (not shown).

[0047] FIG. 9 shows another example embodiment of a TOSA housing 204' in accordance with aspects of the present disclosure. As shown, the TOSA housing 204' includes a plurality of sidewalls to provide a cavity therebetween, which is substantially similar to that of the TOSA housing 204. However, the TOSA housing 204' does not include a multiplexing device within the cavity and instead couples to a first end of a plurality of waveguides (not shown), e.g., optical fibers, via apertures 480-1 to 480-4. A second end of the plurality of waveguides may be optically coupled to an external multiplexing device, such as an AWG. This allows the TOSA 204' to have a relatively small overall footprint, which can significantly reduce overall costs and complexity that characterizes hermetically-sealed housing. Put simply, the lesser the volume and number of passive/optical components within the cavity of the TOSA housing 204', the less the complexity, time and cost necessary to manufacture the TOSA housing 204'. The feedthrough device 262' may be configured substantially similar to that of the feedthrough device 262, the description of which is equally applicable to the embodiment of FIG. 9 but will not be repeated for brevity. For instance, the vertical MPD mounting surface 490 allows for MPDs to be mounted thereon to advantageously reduce the overall length of the TOSA housing 204' relative to other approaches that place MPDs behind or otherwise adjacent corresponding LDs.

[0048] In accordance with an aspect of the present disclosure a transmitter optical subassembly (TOSA) module is disclosed. The TOSA module comprising a laser diode (LD) mounting surface, at least a first LD disposed on the LD mounting surface, the first LD having a back-side emission surface for emitting a portion of optical power along a first optical path, a base portion providing a vertical MPD mounting surface, and a first MPD disposed on the vertical MPD mounting surface, the first MPD having a light receiving region optically aligned with the first LD via the first optical path based at least in part on the vertical MPD mounting surface extending substantially transverse relative to the LD mounting surface such that the first optical path intersects with the light receiving region of the first MPD.

[0049] In accordance with another aspect of the present disclosure a method for optically coupling monitor photodiodes (MPDs) to corresponding laser diodes (LDs) in a multi-channel optical transceiver (TOSA) housing is disclosed. The method comprising mounting at least one MPD to a vertical MPD mounting surface provided by a feedthrough device, patterning a plurality of conductive traces on to one or more surfaces of the feedthrough device, and inserting the feedthrough device into a cavity of the TOSA housing to bring the plurality of conductive traces into close proximity with the LDs in the TOSA, wherein inserting the feedthrough device into the cavity causes each of the at least one MPDs mounted to the vertical MPD mounting surface to optically couple with a back-side emission surface of each corresponding LD.

[0050] In accordance with yet another aspect of the present disclosure a multi-channel optical transceiver module is disclosed. The multi-channel optical transceiver including a printed circuit board assembly (PCBA), a transmitter optical subassembly (TOSA) arrangement coupled to the PCBA, the TOSA arrangement comprising a laser diode (LD) mounting surface, at least a first LD disposed on the LD mounting surface, the first LD having a back-side emission surface for emitting a portion of optical power along a first optical path, a base portion providing a vertical MPD mounting surface, a first MPD disposed on the vertical MPD mounting surface, the first MPD having a light receiving region optically aligned with the first LD via the first optical path based at least in part on the vertical MPD mounting surface extending substantially transverse relative to the LD mounting surface such that the first optical path intersects with the light receiving region of the first MPD.

[0051] While the principles of the disclosure have been described herein, it is to be understood by those skilled in the art that this description is made only by way of example and not as a limitation as to the scope of the disclosure. Other embodiments are contemplated within the scope of the present disclosure in addition to the exemplary embodiments shown and described herein. Modifications and substitutions by one of ordinary skill in the art are considered to be within the scope of the present disclosure, which is not to be limited except by the following claims.

CLAIMS

What is claimed is:

1. A transmitter optical subassembly (TOSA) module, the TOSA module comprising:
 - a laser diode (LD) mounting surface;
 - at least a first LD disposed on the LD mounting surface, the first LD having a back-side emission surface for emitting a portion of optical power along a first optical path;
 - a base portion providing a vertical MPD mounting surface; and
 - a first MPD disposed on the vertical MPD mounting surface, the first MPD having a light receiving region optically aligned with the first LD via the first optical path based at least in part on the vertical MPD mounting surface extending substantially transverse relative to the LD mounting surface such that the first optical path intersects with the light receiving region of the first MPD.
2. The TOSA module of claim 1, further comprising:
 - a housing having a plurality of sidewalls that define a cavity, the LD mounting surface being disposed in the cavity; and
 - a feedthrough device defined at least in part by the base, the feedthrough device configured to at least partially be disposed in the cavity of the housing, and wherein a first end of the feedthrough device provides an electrical coupling region to electrically couple to an optical module substrate to receive a radio frequency (RF) driving signal to drive the first LD, and a second end of the feedthrough device defines the vertical MPD mounting surface, the vertical MPD mounting surface being disposed in the cavity.
3. The TOSA module of claim 2, wherein the cavity of the housing is hermetically sealed to prevent ingress of contaminants.
4. The TOSA module of claim 2, wherein at least one sidewall of the plurality of sidewalls of the housing provides a thermoelectric cooler (TEC) mounting section, and wherein the TOSA provides:

a thermoelectric cooler (TEC) arrangement mounted to the TEC mounting section; and
a LD submount disposed on the TEC arrangement, the LD submount being in thermal communication with the TEC arrangement, and wherein the LD submount provides the LD mounting surface.

5. The TOSA module of claim 1, further comprising a plurality of transmit (TX) radio frequency (RF) traces, the TX RF traces being disposed on a surface of the base that extends away from the vertical mounting surface along a direction that is substantially parallel with the LD mounting surface.

6. The TOSA module of claim 5, wherein the plurality of TX RF traces are disposed below the MPD when mounted to the vertical MPD mounting surface to allow the plurality of TX RF traces to extend towards the LD mounting surface, and wherein a portion of the plurality of TX RF traces are disposed adjacent the LD mounting surface.

7. The TOSA module of claim 1, further comprising a second LD disposed on the LD mounting surface and a second MPD disposed on the vertical MPD mounting surface, the second LD being configured to emit an associated channel wavelength different from that of the first LD, and wherein the second LD and second MPD are optically aligned via a second optical path such that the second optical path extends from a back-side emission surface of the second LD and intersects with a light receiving region of the second MPD.

8. The TOSA module of claim 7, further comprising a multiplexing arrangement, the multiplexing arrangement having at least first and second input ports optically aligned with the first and second optical paths, respectively, to receive and combine channel wavelengths emitted by the first and second LDs into a multiplexed optical signal for output via an output port.

9. The TOSA module of claim 8, wherein the multiplexing arrangement includes an arrayed waveguide grating AWG to multiplex the received channel wavelengths, and wherein AWG provides the output port and passes the multiplexed optical signal on to a transmit waveguide coupled to the output port.

10. The TOSA module of claim 8, wherein the first and second input ports of the multiplexing arrangement are angled relative to the light emitting region of the first and second LDs such that incident channel wavelengths received along the first and second optical paths intersect at an angle of about 8 degrees to prevent back reflection.

11. The TOSA module of claim 1 implemented in a multi-channel transceiver capable of sending and receiving at least four different channel wavelengths.

12. A method for optically coupling monitor photodiodes (MPDs) to corresponding laser diodes (LDs) in a multi-channel optical transceiver (TOSA) housing, the method comprising:

mounting at least one MPD to a vertical MPD mounting surface provided by a feedthrough device;

patterning a plurality of conductive traces on to one or more surfaces of the feedthrough device; and

inserting the feedthrough device into a cavity of the TOSA housing to bring the plurality of conductive traces into close proximity with the LDs in the TOSA, wherein inserting the feedthrough device into the cavity causes each of the at least one MPDs mounted to the vertical MPD mounting surface to optically couple with a back-side emission surface of each corresponding LD.

13. The method of claim 12, further comprising introducing an inert gas into the cavity to form a hermetic seal.

14. The method of claim 12, further comprising introducing wire bonds between the LDs and the plurality of conductive traces after insertion of the feedthrough device into the cavity of the TOSA housing.

15. The method of claim 12, wherein patterning the plurality of conductive traces includes disposing each conductive trace of the plurality of conductive traces on to a surface that extends below the vertical MPD mounting surface.

16. A multi-channel optical transceiver module comprising:
a printed circuit board assembly (PCBA);
a transmitter optical subassembly (TOSA) arrangement coupled to the PCBA, the TOSA arrangement comprising:
a laser diode (LD) mounting surface;
at least a first LD disposed on the LD mounting surface, the first LD having a back-side emission surface for emitting a portion of optical power along a first optical path;
a base portion providing a vertical MPD mounting surface;
a first MPD disposed on the vertical MPD mounting surface, the first MPD having a light receiving region optically aligned with the first LD via the first optical path based at least in part on the vertical MPD mounting surface extending substantially transverse relative to the LD mounting surface such that the first optical path intersects with the light receiving region of the first MPD.

17. The multi-channel optical transceiver of claim 16, wherein the TOSA arrangement further comprises:

a TOSA housing having a plurality of sidewalls that define a cavity, the LD mounting surface being disposed in the cavity; and
a feedthrough device defined at least in part by the base, the feedthrough device configured to at least partially be disposed in the cavity of the TOSA housing, and wherein a first end of the feedthrough device provides an electrical coupling region to electrically couple to an optical module substrate to receive a radio frequency (RF) driving signal to drive the first LD, and a second end of the feedthrough device defines the vertical MPD mounting surface, the vertical MPD mounting surface being disposed in the cavity of the TOSA housing.

18. The multi-channel optical transceiver of claim 17, wherein the cavity of the TOSA housing is hermetically sealed to prevent ingress of contaminants.

19. The multi-channel optical transceiver of claim 17, wherein at least one sidewall of the plurality of sidewalls of the TOSA housing provides a thermoelectric cooler (TEC) mounting section, and wherein the TOSA provides:

a thermoelectric cooler (TEC) arrangement mounted to the TEC mounting section; and

a LD submount disposed on the TEC arrangement, the LD submount being in thermal communication with the TEC arrangement, and wherein the LD submount provides the LD mounting surface.

20. The multi-channel optical transceiver of claim 15, further comprising a plurality of transmit (TX) radio frequency (RF) traces, the TX RF traces being disposed on a surface of the base portion that extends away from the vertical mounting surface along a direction that is substantially parallel with the LD mounting surface, and wherein the TX RF traces are disposed below the MPD when mounted to the vertical MPD mounting surface to allow the TX RF traces to extend towards the LD mounting surface.

TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

ABSTRACT

The present disclosure is generally directed to a multi-channel TOSA with vertically-mounted MPDs to reduce TOSA housing dimensions and improve RF driving signal quality. In more detail, a TOSA housing consistent with the present disclosure includes at least one vertical MPD mounting surface that extends substantially transverse relative to a LD mounting surface, with the result being that a MPD coupled to the vertical MPD mounting surface gets positioned above an associated LD coupled to the LD mounting surface. The vertically-mounted MPD thus makes regions adjacent an LD that would otherwise be utilized to mount an MPD available for patterning of conductive RF traces to provide an RF driving signal to the LD. The conductive RF traces may therefore extend below the vertically-mounted MPD to a location that is proximate the LD to allow for relatively short wire bonds therebetween.

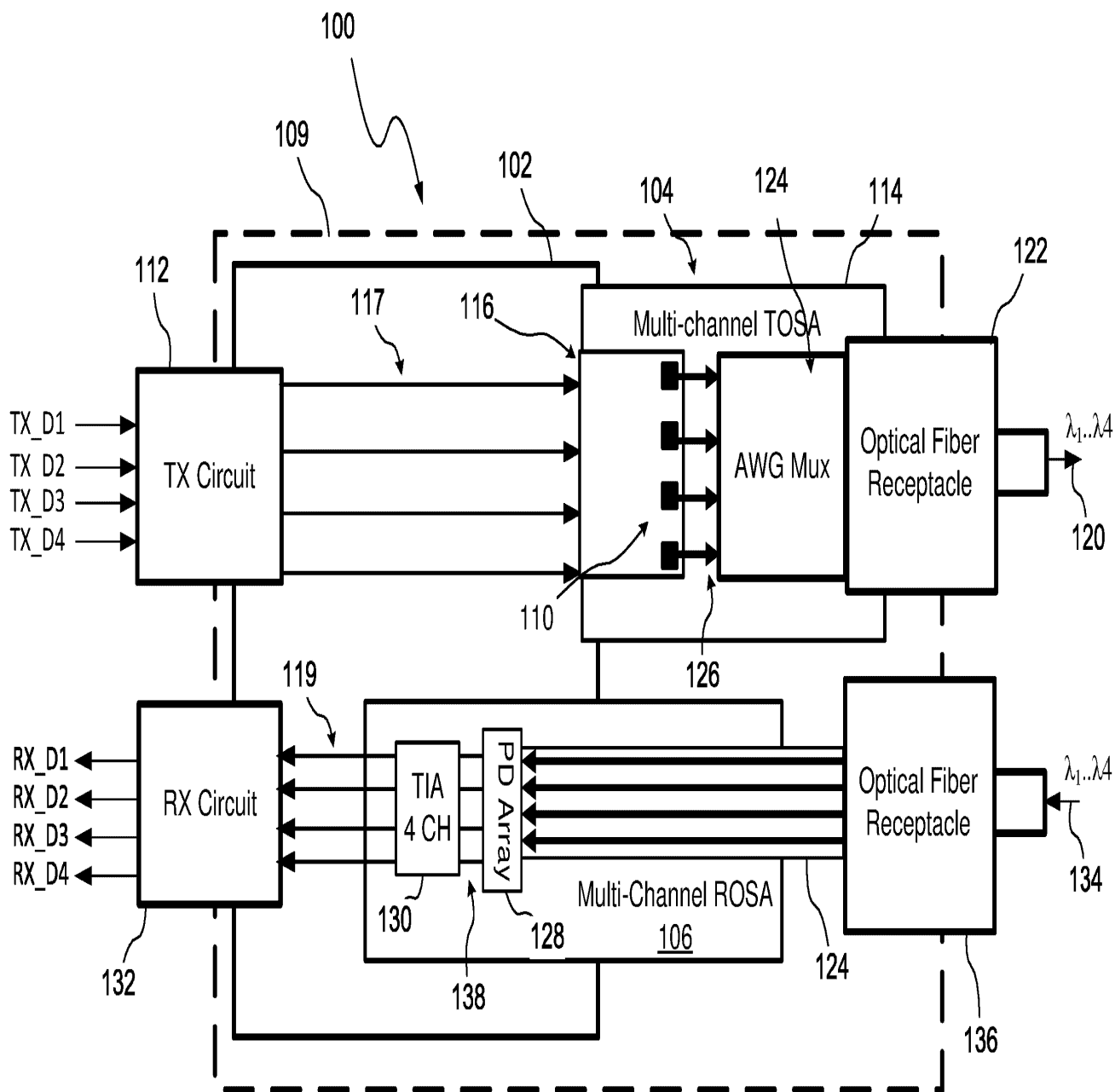
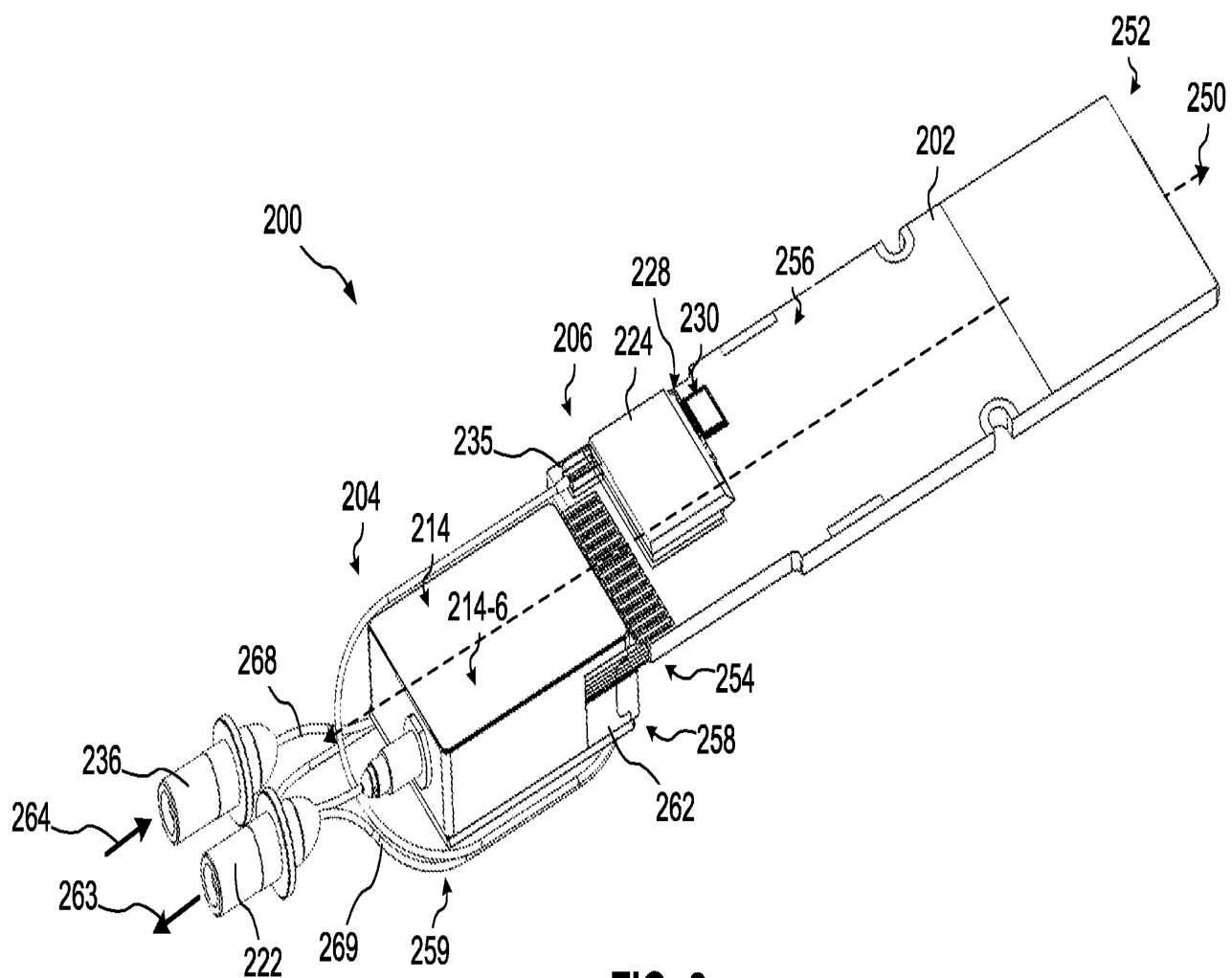
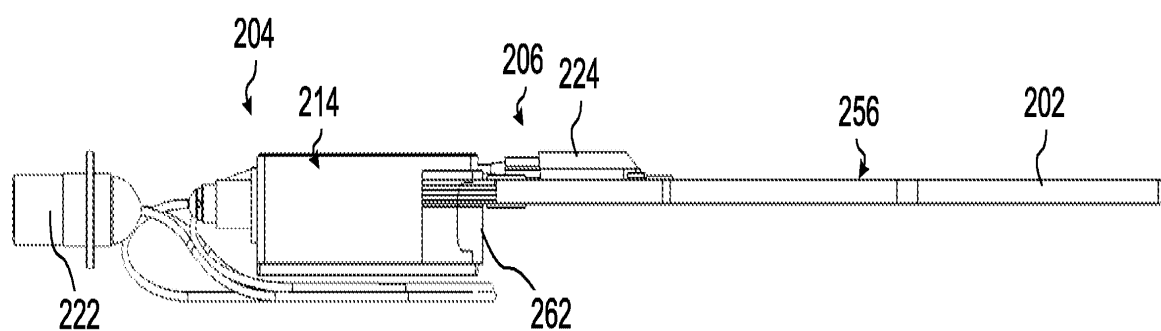


FIG. 1



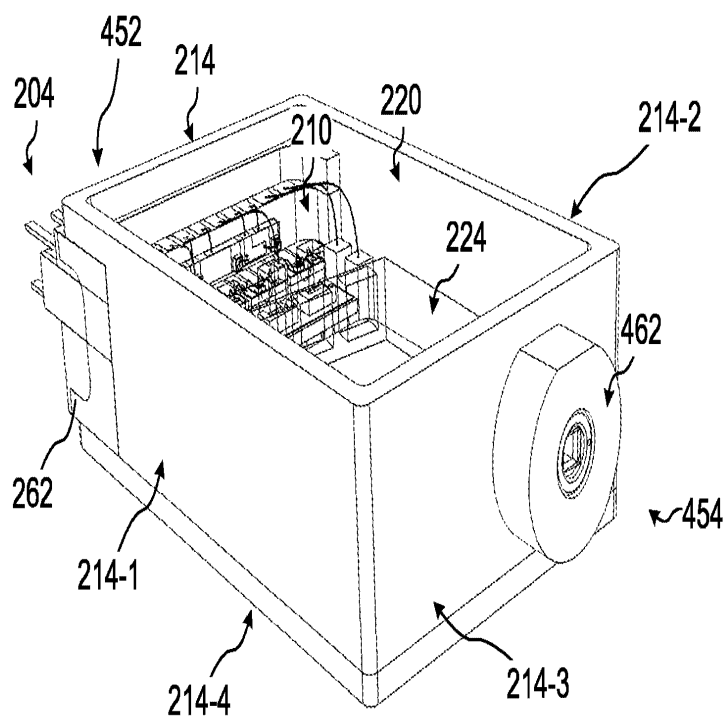


FIG. 4

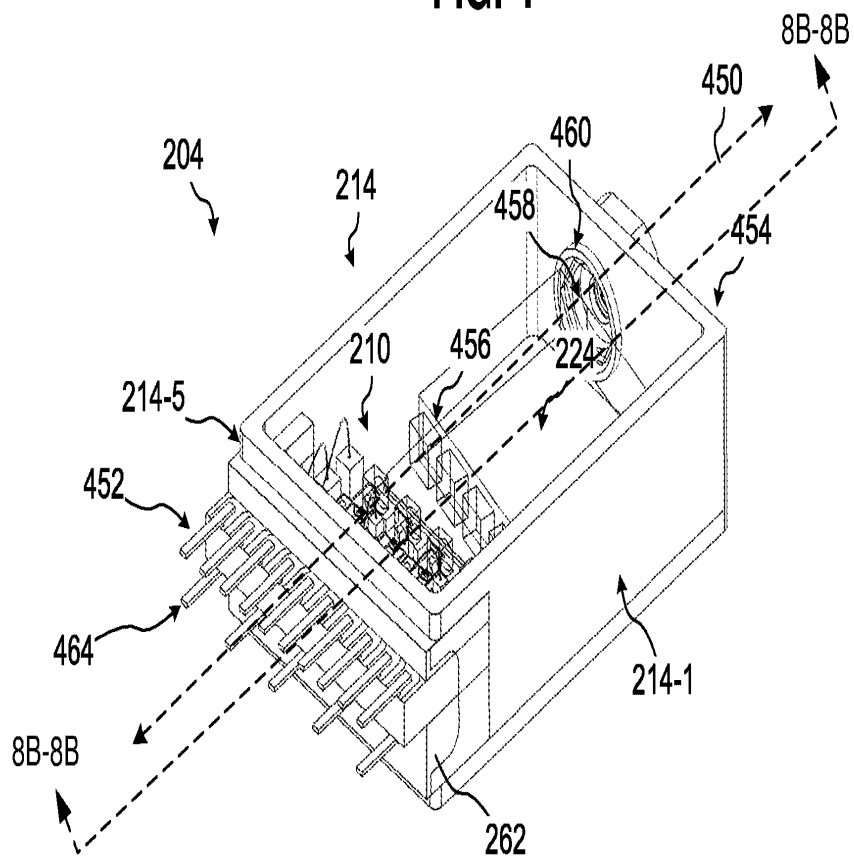


FIG. 5

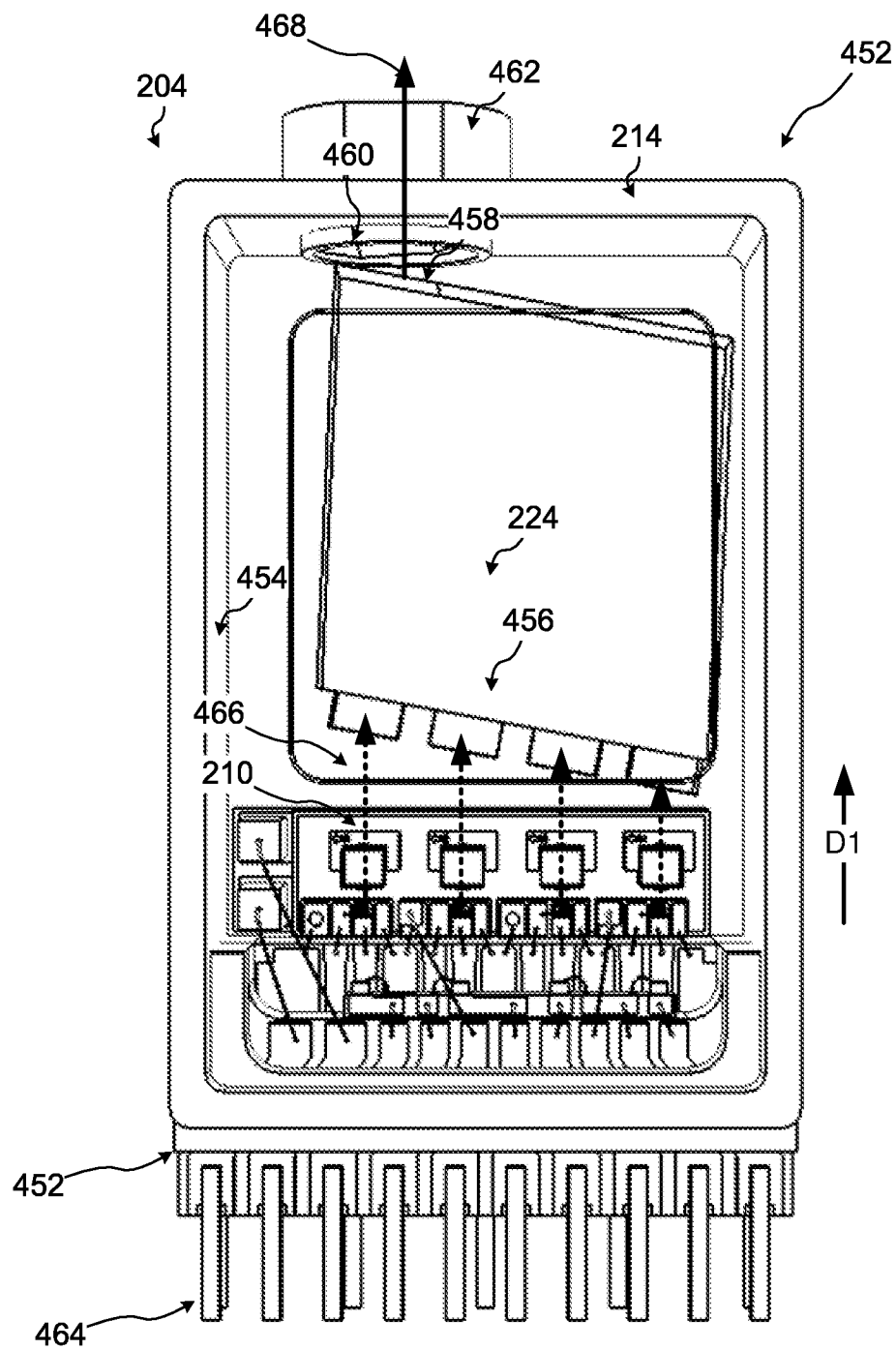


FIG. 6

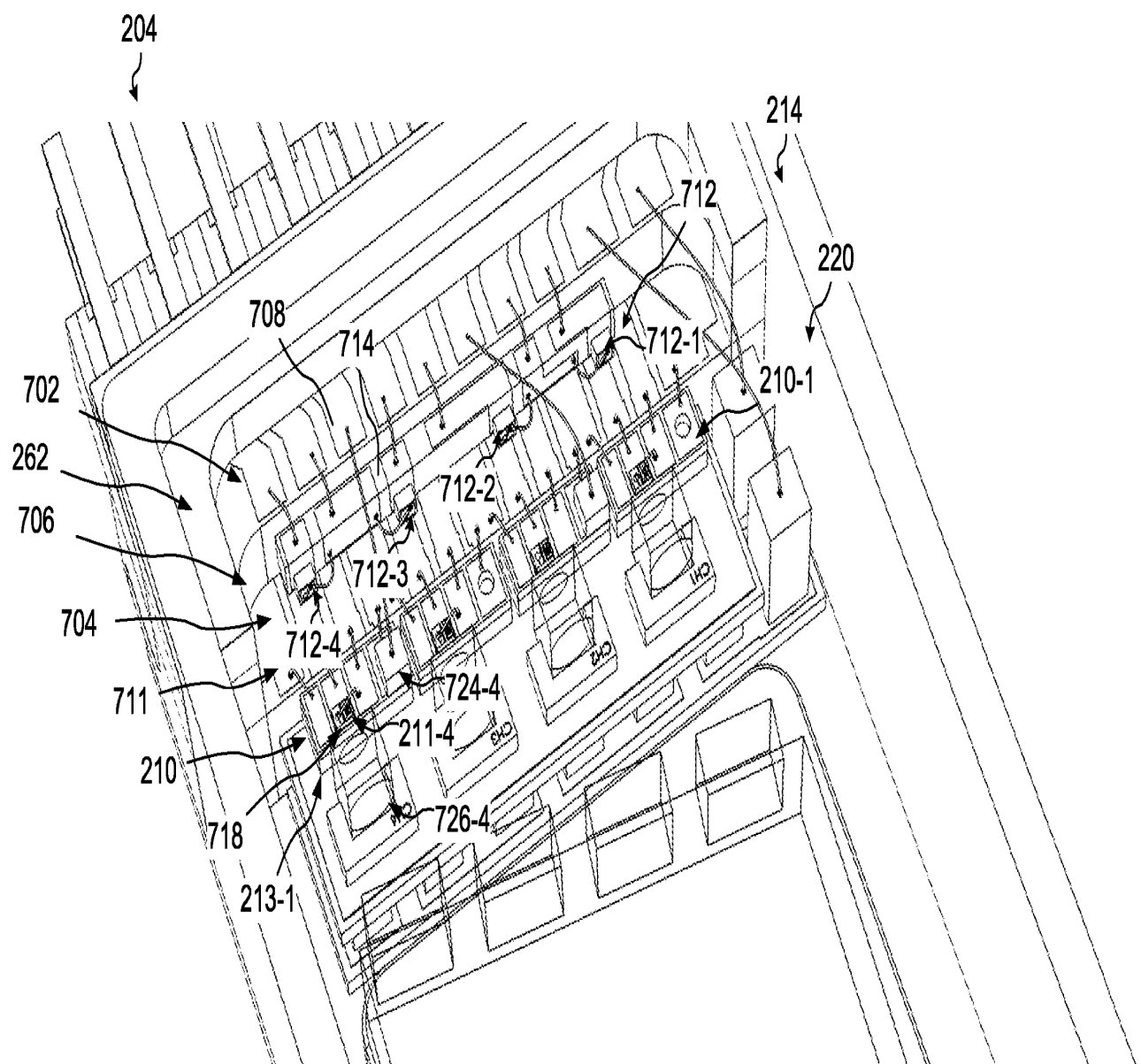


FIG. 7

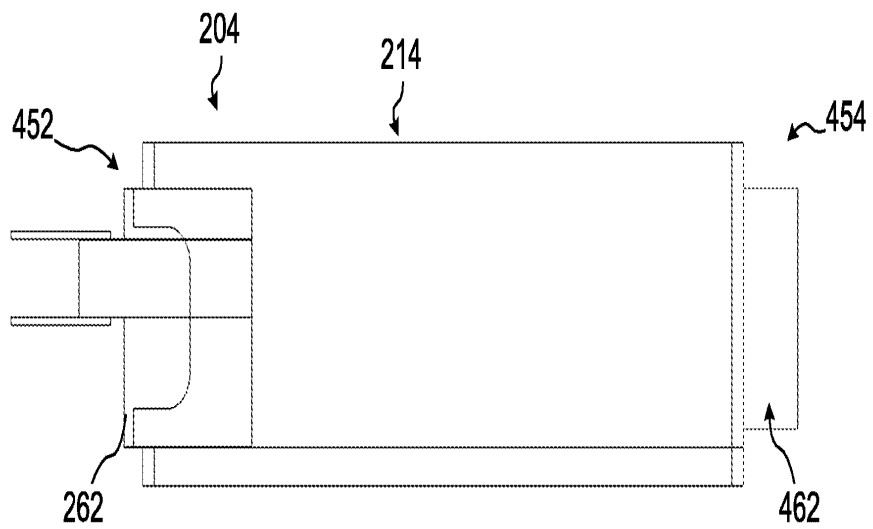


FIG. 8A

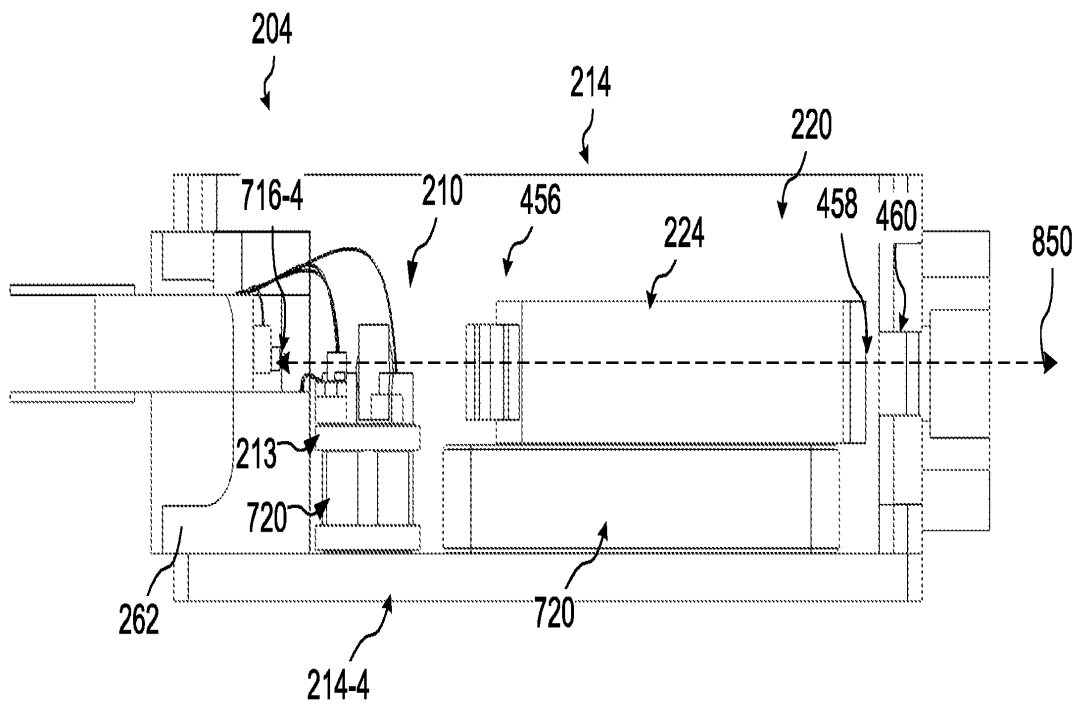


FIG. 8B

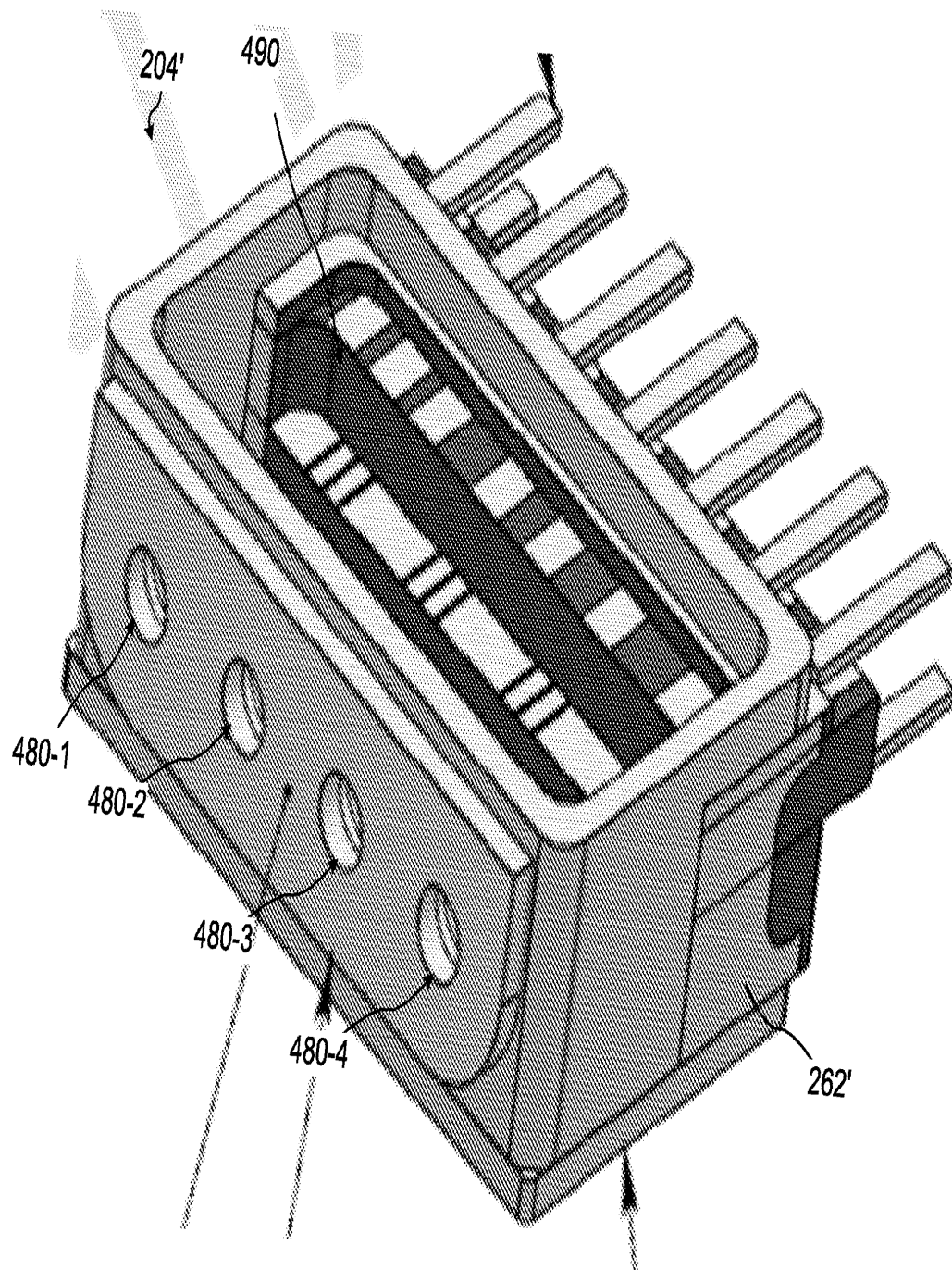


FIG. 9

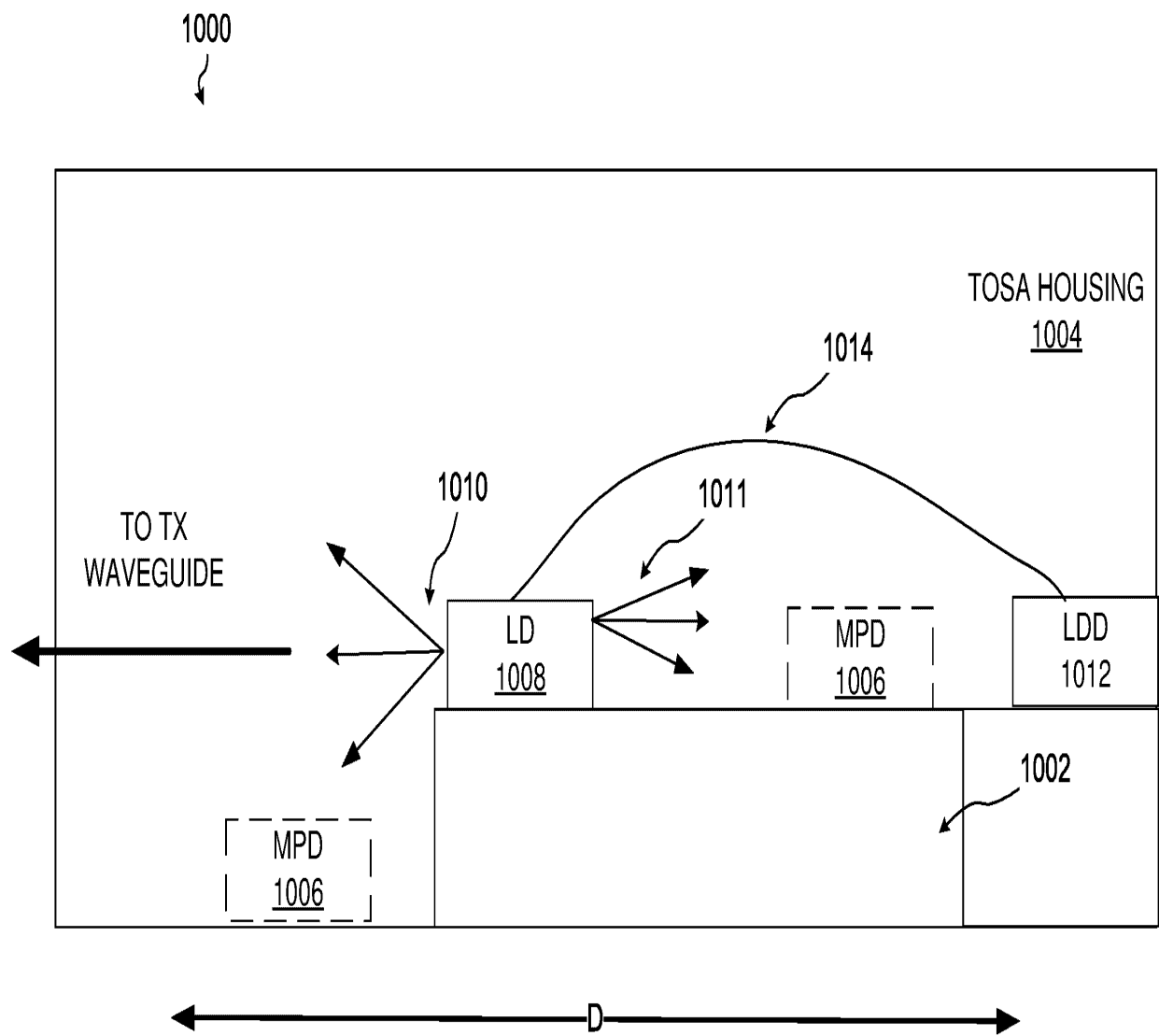


FIG. 10

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES			
First Named Inventor/Applicant Name:	Kai-Sheng LIN			
Filer:	Kenneth M. Thompson/April Davis			
Attorney Docket Number:	PAT266-002US			
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1720

Electronic Acknowledgement Receipt

EFS ID:	35073866
Application Number:	16268765
International Application Number:	
Confirmation Number:	3070
Title of Invention:	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES
First Named Inventor/Applicant Name:	Kai-Sheng LIN
Customer Number:	27543
Filer:	Kenneth M. Thompson/April Davis
Filer Authorized By:	Kenneth M. Thompson
Attorney Docket Number:	PAT266-002US
Receipt Date:	06-FEB-2019
Filing Date:	
Time Stamp:	13:02:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 1720
RAM confirmation Number	020619INTEFSW00010092501705
Deposit Account	501705
Authorized User	April Davis

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)
37 CFR 1.20 (Post Issuance fees)
37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	PAT266_002US_ADS.pdf	1822686	no	9
			11804a58ec8c0feb7231b3425ba42a9353a55d6		
Warnings:					
Information:					
2	Oath or Declaration filed	PAT266_002US_DECLARATION_Executed.pdf	679240	no	2
			4ce9b58ad3d64050572e213ddcc07d13f5a1fc9b		
Warnings:					
Information:					
3	Power of Attorney	AOI_GENERAL_POA.pdf	37470	no	1
			3080c133b72c5782a34e68c344de8d065cdfb7d4		
Warnings:					
Information:					
4		PAT266_002US_Application_as filed_020619.pdf	121916	yes	20
			5e2fe4ed7bf2bab4e7de28dc7b61e907d79fee1e		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	14	
	Claims		15	19	
	Abstract		20	20	
Warnings:					
Information:					
5	Drawings-only black and white line drawings	PAT266_002US_Drawings_asfiled_020619.pdf	1072212	no	8
			c9ae098a2b2d545ec538585a6b58a681b0949088		

Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	34994	no	2
			b257ef1183272579dce6386a37da082621e3c6ac		
Warnings:					
Information:					
Total Files Size (in bytes):				3768518	
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PAT266-002US
		Application Number	
Title of Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES		
<p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.</p> <p>This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p>			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor	1				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Kai-Sheng		LIN		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	Sugar Land	State/Province	TX	Country of Residence	US

Mailing Address of Inventor:

Address 1	1306 Leigh Gardens Drive				
Address 2					
City	Sugar Land	State/Province	TX		
Postal Code	77479	Country	US		

Inventor	2				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Hsiu-Che		WANG		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	Rosenberg	State/Province	TX	Country of Residence	US

Mailing Address of Inventor:

Address 1	9323 Hillhaven Ct				
Address 2					
City	Rosenberg	State/Province	TX		
Postal Code	77469	Country	US		

Inventor	3				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Kevin		LIU		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		PAT266-002US	
		Application Number			
Title of Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES				
City	Houston	State/Province	TX	Country of Residence	US
Mailing Address of Inventor:					
Address 1	3230 S. Gessner Rd., Apt. 606				
Address 2					
City	Houston	State/Province	TX		
Postal Code	77063	Country	US		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					<input type="button" value="Add"/>

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence information of this application.			
Customer Number	27543		
Email Address	kcarroll@gtp.com	<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>

Application Information:

Title of the Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES		
Attorney Docket Number	PAT266-002US	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	8	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PAT266-002US
		Application Number	
Title of Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES		

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	27543		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	<input type="text"/>	<input type="button" value="Remove"/>
Application Number	Continuity Type	Prior Application Number
<input type="text"/>	<input type="text"/>	<input type="text"/>
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.		

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PAT266-002US
		Application Number	
Title of Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES		

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

<p>This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.</p> <p>☐ NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.</p>	
--	--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PAT266-002US
		Application Number	
Title of Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PAT266-002US
		Application Number	
Title of Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant	1	Remove
<p>If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.</p> <p style="text-align: right;">Clear</p>		
☒ Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.		Person who shows sufficient proprietary interest
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:		
<div style="border: 1px solid black; height: 20px; width: 100%;"></div>		
Name of the Deceased or Legally Incapacitated Inventor: <div style="border: 1px solid black; height: 20px; width: 100%;"></div>		
If the Applicant is an Organization check here. ☒		
Organization Name	Applied Optoelectronics, Inc.	
Mailing Address Information For Applicant:		
Address 1	13139 Jess Pirtle Blvd.	
Address 2		
City	Sugar Land	State/Province TX
Country	US	Postal Code 77478
Phone Number		Fax Number
Email Address		
Additional Applicant Data may be generated within this form by selecting the Add button. Add		

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PAT266-002US
		Application Number	
Title of Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES		

Assignee	1			
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
				<input type="button" value="Remove"/>
If the Assignee or Non-Applicant Assignee is an Organization check here.				☐
Prefix	Given Name	Middle Name	Family Name	Suffix
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1		<input type="text"/>		
Address 2		<input type="text"/>		
City	<input type="text"/>	State/Province	<input type="text"/>	
Country ⁱ	<input type="text"/>	Postal Code	<input type="text"/>	
Phone Number	<input type="text"/>	Fax Number	<input type="text"/>	
Email Address	<input type="text"/>			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.				<input type="button" value="Add"/>

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Kenneth M. Thompson/		Date (YYYY-MM-DD)	2019-02-06
First Name	Kenneth M.	Last Name	Thompson	Registration Number
				72001
Additional Signature may be generated within this form by selecting the Add button.				<input type="button" value="Add"/>

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PAT266-002US
		Application Number	
Title of Invention	TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Declaration for United States Patent Application

TITLE OF APPLICATION: TRANSMITTER OPTICAL SUBASSEMBLY ARRANGEMENT WITH VERTICALLY-MOUNTED MONITOR PHOTODIODES

As a below named inventor, I hereby declare that:

This declaration is directed to:

☒ the attached application, or

☐ United States Application No. or PCT Application No. _____ filed on _____, 20____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the application, including the claims, and I am aware of the duty to disclose to the Office all information known to the person to be material to patentability as defined in 37 C.F.R. § 1.56 (attached hereto).

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Kai-Sheng LIN

Full name of sole or first inventor

Sole or first inventor's signature

Date

1/24/2019

Hsiu-Che WANG

Full name of additional inventor, if any

Additional inventor's signature

Date

1/24/2019

Kevin LIU

Full name of additional inventor, if any

Additional inventor's signature

Date

1/24/2019

§ 1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) prior art cited in search reports of a foreign patent office in a counterpart application, and
- (2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

- (1) It establishes, by itself or in combination with other information, a *prima facie* case of unpatentability of a claim; or
- (2) It refutes, or is inconsistent with, a position the applicant takes in:
 - (i) Opposing an argument of unpatentability relied on by the Office, or
 - (ii) Asserting an argument of patentability.

A *prima facie* case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

- (1) Each inventor named in the application;
- (2) Each attorney or agent who prepares or prosecutes the application; and
- (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

SCORE Placeholder Sheet for IFW Content

Application Number: 16268765

Document Date: 02/06/2019

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

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