

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
28 February 2008 (28.02.2008)

PCT

(10) International Publication Number  
**WO 2008/024183 A3**

(51) International Patent Classification:

*H04B 10/00* (2006.01)    *G02F 1/01* (2006.01)  
*H04B 10/04* (2006.01)    *G02F 1/035* (2006.01)  
*H04B 10/12* (2006.01)

(21) International Application Number:

PCT/US2007/017159

(22) International Filing Date: 1 August 2007 (01.08.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/840,220                    24 August 2006 (24.08.2006)    US

(71) Applicant (for all designated States except US):

**EOSPACE, INC.** [US/US]; 8711 148th Avenue, N.E.,  
Redmond, WA 98052 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **THANIYAVARN,  
Suwat** [US/US]; 8711 148th Avenue, N.E., Redmond, WA  
98052 (US).

(74) Agents: **WRAY, James, C.** et al.; 1493 Chain Bridge  
Road, Suite 300, McLean, VA 22101 (US).

(81) Designated States (unless otherwise indicated, for every

kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

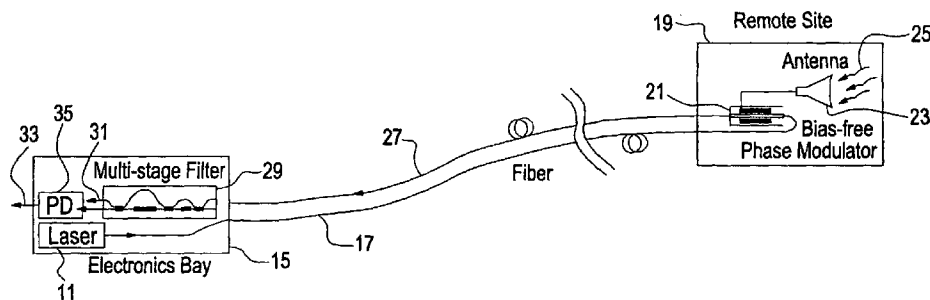
Published:

— with international search report

(88) Date of publication of the international search report:

19 June 2008

(54) Title: HIGH-DYNAMIC-RANGE ANALOG FIBER-OPTIC LINK USING PHASE MODULATION AND TUNABLE OPTICAL FILTER



(57) Abstract: A cw-laser source transmits low-noise, narrow-linewidth optical power via an optical fiber (17) to a bias-free electro-optic phase modulator (21) at a remote site (19), where an antenna or an RF sensor (23) is located. The RF electrical signal modulates the phase modulator at the remote site, converting an electrical signal into an optical signal. The phase-modulated optical signal is fed back via the optical fiber to an optical filter (29) whose filter transfer characteristics can be tuned and reconfigured to cancel the intermodulation distortion terms, particularly the dominant 3rd order intermodulation, as well as the 2nd order. The filtered optical signal is converted to the RF signal at the photodetector (35). The optical filter is used to effectively "linearize" the signal at the receiver end, rather than at the modulator end.



WO 2008/024183 A3

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US07/17159

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC: **H04B 10/00**( 2006.01),**10/04**( 2006.01),**10/12**( 2006.01);**G02F 1/01**( 2006.01),**1/035**( 2006.01)  
  
 USPC: 385/1,2,3;398/115,116,117,141,183,188,201,207  
 According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**  
 Minimum documentation searched (classification system followed by classification symbols)  
 U.S. : 385/1,2,3; 398/115,116,117,141,183,188,201,207

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 Please See Continuation Sheet

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,115,162 (GRAVES et al) 05 September 2000 (05.09.2000), figures 2 and 4, column 2, line 45, through column 4, line 20.	1, 2, 11, and 12
A	US 6,643,417 B2 (STRUTZ et al) 04 November 2003 (04.11.2003), figures 3 and 4, column 4, line 7 through column 5, line 5.	1, 2, 11, and 12
A	US 2003/0030868 A1 (SASAI et al) 13 February 2003 (13.02.2003), figure 1, paragraph [0126] through paragraph [0131].	1, 2, 11, and 12

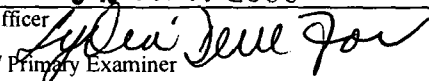
Further documents are listed in the continuation of Box C.       See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  
 26 March 2008 (26.03.2008)

Date of mailing of the international search report  
**02 APR 2008**

Name and mailing address of the ISA/US  
 Mail Stop PCT, Attn: ISA/US  
 Commissioner for Patents  
 P.O. Box 1450  
 Alexandria, Virginia 22313-1450  
 Facsimile No. (571) 273-3201

Authorized officer  
  
 /Tina Wong/ Primary Examiner  
 Telephone No. (571) 272-2352

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US07/17159

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: 3-10 and 13-24  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
Please See Continuation Sheet
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  2.  As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of any additional fees.
  3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
  4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
  - The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
  - No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US07/17159

## Continuation of Box II Reason 2:

Independent claims 1 and 11 define the optical filter to be a "multi stage tunable optical filter". However, dependent claims 3-10 and 13-24 attempt to further define an optical filter in a different manner, although the filter has already been more narrowly defined in the independent claims 1 and 11. It is presented in the independent claims as being only one filter.

## Continuation of B. FIELDS SEARCHED Item 3:

EAST searched; search terms: (phas\$5 near4 modulat\$5), ("RF" or (radio near4 frequenc\$4)), filter\$5, (diode or photodiode or receiver), laser\$5, ((tune or tuning or tunable or tuned or tunes) near4 filter\$5)