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[Continued on next page]

(54) Title: PHOTONIC DATA TRANSFER ASSEMBLY

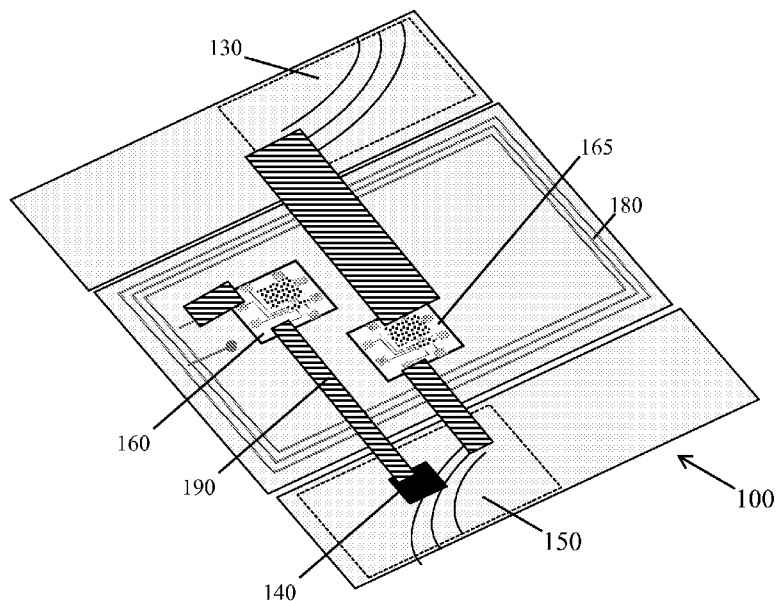


FIG. 2

[Continued on next page]



TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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**Declarations under Rule 4.17:**

— of inventorship (Rule 4.17(iv))

**Published:**

— with international search report (Art. 21(3))

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

30 October 2014

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**(57) Abstract:** The described Photonic Data Transfer Assembly (100) is a flexible device capable of receiving, processing and transmitting photonic signals which can be activated, deactivated, tuned and controlled by included electronic circuitry which may be controlled wirelessly using Radio Frequency (RF) communication. Flexible photonic waveguides and flexible electronic circuits are integrated with flexible interconnects into a smart card format only 0.25 mm thick.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2014/014740

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(8) - G02B 6/12 (2014.01) USPC - 385/14 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC(8) - G02B 6/12, 6/26, 6/10 (2014.01) USPC - 385/14, 15, 129, 130, 132; 398/164 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - G02B 6/43, 6/12004, 6/12007 (2014.02) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, ProQuest		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0129786 A1 (DEANE) 21 May 2009 (21.05.2009) entire document	1-5, 21-28
Y	US 2006/0072297 A1 (GOODWIN) 06 April 2006 (06.04.2006) entire document	1-5
Y	US 2013/0028147 A1 (BLACK) 31 January 2013 (31.01.2013) entire document	5
Y	US 2003/0031446 A1 (GAO et al) 13 February 2003 (13.02.2003) entire document	6-15
Y	US 2003/0057525 A1 (FOCK et al) 27 March 2003 (27.03.2003) entire document	6-15, 17, 22
Y	US 2003/0133682 A1 (TEMKIN et al) 17 July 2003 (17.07.2003) entire document	9
Y	US 2002/0106165 A1 (ARSENAULT et al) 08 August 2002 (08.08.2002) entire document	11-13
Y	US 5,528,222 A (MOSKOWITZ et al) 18 June 1996 (18.06.1996) entire document	16-20
Y	US 6,288,443 B1 (FINN et al) 11 September 2001 (11.09.2001) entire document	16-20
Y	US 2005/0024290 A1 (AISENBREY) 03 February 2005 (03.02.2005) entire document	19
Y	US 6,343,744 B1 (SHIBATA et al) 05 February 2002 (05.02.2002) entire document	20
Y	US 2004/0178484 A1 (BURDICK et al) 16 September 2004 (16.09.2004) entire document	21-28
Y	US 2007/0231953 A1 (TOMITA et al) 04 October 2007 (04.10.2007) entire document	23
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "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 "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 "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 "&" document member of the same patent family		
Date of the actual completion of the international search 13 August 2014		Date of mailing of the international search report <b>02 SEP 2014</b>
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: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2014/014740

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/0328028 A1 (DEKKER et al) 30 December 2010 (30.12.2010) entire document	24
Y	US 2009/0152100 A1 (DALAL et al) 18 June 2009 (18.06.2009) entire document	25
Y	US 2006/0237838 A1 (FERY et al) 26 October 2006 (26.10.2006) entire document	26
Y	US 2006/0079127 A1 (ENDO et al) 13 April 2006 (13.04.2006) entire document	27-28
Y	US 5,659,153 A (NARAYAN et al) 19 August 1997 (19.08.1997) entire document	28
A	WO 2012/145605 A1 (LIU et al) 26 October 2012 (26.10.2012) entire document	1-28

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2014/014740

## 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.:  
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:
  
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:  
see extra sheet

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 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/US2014/014740

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-5, drawn to an assembly comprising: wherein the assembly is capable of sustained data transfer during flexure or other deformation into a non-planar configuration.

Group II, claims 6-13, drawn to a flexible photonic waveguide comprising: a first layer of isolation material on the substrate; a sub-micron single crystalline Semiconductor-On-Polymer (SOP) layer on the first isolation layer.

Group III, claims 14, 15, drawn to a method of forming a flexible photonic waveguide, preparing a photonic circuit on a semiconductor substrate; removing the semiconductor substrate; and transferring the photonic circuit to a flexible support.

Group IV, claims 16-20, drawn to a flexible transponder.

Group V, claims 21-28, drawn to an interconnect.

The inventions listed as Groups I, II, III, IV and V do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical feature of the Group I invention: an assembly comprising: a flexible substrate; a flexible optical circuit on the flexible substrate for reception and/or transmission of a photonic signal, a flexible microelectronic circuit on the flexible substrate for wireless reception and/or transmission of an electrical signal; and at least one flexible interconnect, wherein the at least one flexible interconnect couples the flexible optical circuit and the flexible microelectronic circuit to enable the assembly for data transfer, and wherein the assembly is capable of sustained data transfer during flexure or other deformation into a non-planar configuration, as claimed therein is not present in the invention of Groups II, III, IV or V.

The special technical feature of the Group II invention: a flexible photonic waveguide comprising: a flexible substrate; a first layer of isolation material on the substrate; a sub-micron single crystalline Semiconductor-On-Polymer (SOP) layer on the first isolation layer; and a second layer of isolation material on the SOP layer, wherein the SOP layer comprises photonic circuitry, and wherein an optical mode of light entering or generated within the SOP layer is confined to the SOP layer, as claimed therein is not present in the invention of Groups I, IV or V.

The special technical feature of the Group III invention: a method of forming a flexible photonic waveguide, comprising: preparing a photonic circuit on a semiconductor substrate; removing the semiconductor substrate; and transferring the photonic circuit to a flexible support, as claimed therein is not present in the invention of Groups I, IV or V.

The special technical feature of the Group IV invention: a flexible transponder comprising: a flexible substrate; a flexible microelectronic circuit constructed on the flexible substrate, wherein the flexible microelectronic circuit is capable of radio frequency operation; and a flexible antenna coupled to the microelectronic circuit, wherein the flexible antenna is congruent with or conformable to the flexible substrate, as claimed therein is not present in the invention of Groups I, II, III or V.

The special technical feature of the Group V invention: an interconnect comprising: a flexible non-conductive material; and a pattern of flexible conductive material on the flexible non-conductive material, wherein the pattern includes at least two connection pads coupled by a line, and wherein the interconnect is flexible, and wherein a total thickness of the interconnect does not exceed 50  $\mu\text{m}$ , as claimed therein is not present in the invention of Groups I, II, III or IV.

Groups I, II, III, IV and V lack unity of invention because even though the inventions of these groups require the technical feature of a flexible photonic waveguide and substrate, this technical feature is not a special technical feature as it does not make a contribution over the prior art. Specifically, WO 2012/145605 A1 (LIU et al) 26 October 2012 (26.10.2012) teaches flexible photonic waveguide (para 14) and substrate (para 14).

Since none of the special technical features of the Group I, II, III, IV or V inventions are found in more than one of the inventions, unity of invention is lacking.