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(54) Title: MULTI-MODE RECEIVER FOR HIGHLY-SPECTRALLY-EFFICIENT COMMUNICATIONS

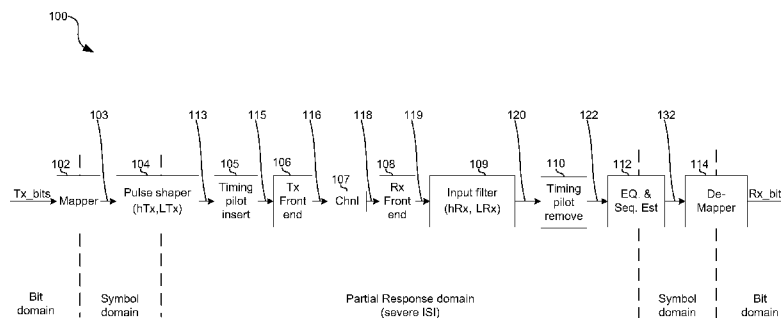


FIG. 1A

(57) Abstract: A receiver may be dynamically configurable, during run-time, into a plurality of modes of operation. In a first mode of operation the receiver may demodulate received signals having relative low inter-symbol correlation using a near zero ISI filter and symbol slicing. In a second mode of operation the receiver may demodulate received signals having relatively high inter-symbol correlation using an input filter configured to achieve a desired total partial response and a sequence estimation algorithm.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 13/01930

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(8) - H04B 1/12 (2014.01); H04W 88/06 (2014.01) USPC - 375/316 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) USPC: 375/316; IPC(8): H04B 1/12 (2014.01); H04W 88/06 (2014.01)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched other: USPC: 375/316,317,320,324,340,343; 455/234.1,234.2,150.1; IPC(8): H04B 1/12 (2014.01); H04W 88/06 (2014.01)		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatBase, PubWEST(PGPB,USPT,USOC,EPAB,JPAB), Google Scholar terms: near zero positive, root raised cosine, intersymbol, partial response, pulse shaping, power back-off, dynamic, adaptive, noise, forward error correction, rate, control, feedback, request, symbol detection, estimate, receiver, input filter, ISI, ISC, iterative, turbo, LDPC		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,135,057 A (Bayless et al.) 16 January 1979 (16.01.1979), entire document, especially abstract, fig. 1, 4, 8-9, 18-21, col 3, ln 47 - col 5, ln 67, col 8, ln 1-17, col 15, ln 47-57, col 18, ln 44-52.	1-2, 11 ----- 3-10, 20
Y	US 2008/0207143 A1 (Skarby et al.) 28 August 2008 (28.08.2008), entire document, especially fig. 7, para [0027]-[0035].	3-5
Y	US 2004/0037374 A1 (Gonikberg) 26 February 2004 (26.02.2004), entire document, especially fig. 2, para [0005], [0020], [0028], [0040]-[0043].	6, 20
Y	US 2011/0275338 A1 (Seshadri et al.) 10 November 2011 (10.11.2011), entire document, especially fig. 6, 15-16 para [0013], [0024]-[0025], [0066]-[0067], [0086], [0092]-[0093], [0135]-[0142], [0147].	7-9
Y	US 2011/0164492 A1 (Ma et al.) 07 July 2011 (07.07.2011), entire document, especially fig. 15, para [0050], [0080], [0088], [0112], [0136].	10
A	US 5,291,516 A (Dixon et al.) 01 March 1994 (01.03.1994), entire document.	1-11, 20
A	US 2009/0086808 A1 (Liu et al.) 02 April 2009 (02.04.2009), entire document.	1-11, 20
<input 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 23 April 2014 (23.04.2014)		Date of mailing of the international search report <b>15 MAY 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: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/IB 13/01930

**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.:  
1-11, 20

- 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/IB 13/01930

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

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 1-11 and 20: drawn to a system having a receiver configured to operate in two modes including a first mode wherein an input filter of said receiver is configured as a near zero positive ISI filter and in the second mode wherein the receiver is configured for reception of an inter-symbol correlated (ISC) signal.

Group II: claims 12-19: drawn to a receiver with a symbol detection circuit configurable to operate in two configurations, wherein a first configuration uses symbol slicing and the second configuration uses sequence estimation algorithm, and an input filter circuit is provided to operate in at least two configuration wherein the first configuration uses a first set of filter taps and second configuration uses a second set of filter taps.

The inventions listed as Groups I and II 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:

Special technical features:

Group I requires a near zero positive ISI filter and is configured in a second mode for reception of an ISC signal which is not required by group II.

Group II requires a first and second configuration which in a first configuration utilizes symbol slicing and a second configuration sequence estimation algorithm along with a filter that has two configuration and two sets of respective filter taps which are not required by group I.

Shared Features:

The only technical features shared by Groups I and II that would otherwise unify the groups are a receiver having two modes or configurations with an input filter.

However, these shared technical features do not represent a contribution over prior art, because the shared technical features are disclosed by US 5,291,516 A to Dixon et al. (hereinafter 'Dixon') 01 March 1994 (01.03.1994), which discloses a receiver having two modes or configurations with an input filter (col 2, ln 47-68).

As the shared technical features were known in the art at the time of the invention, they cannot be considered special technical features that would otherwise unify the groups.

Groups I and II therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.