



(43) International Publication Date  
22 November 2012 (22.11.2012)

(51) International Patent Classification:  
*H04B 1/52* (2006.01)

(21) International Application Number:  
PCT/US2012/038172

(22) International Filing Date:  
16 May 2012 (16.05.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
13/108,905 16 May 2011 (16.05.2011) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, 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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

**Published:**

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

(88) Date of publication of the international search report:  
28 March 2013

(54) Title: RECEIVER WITH TRANSMIT SIGNAL CANCELLATION

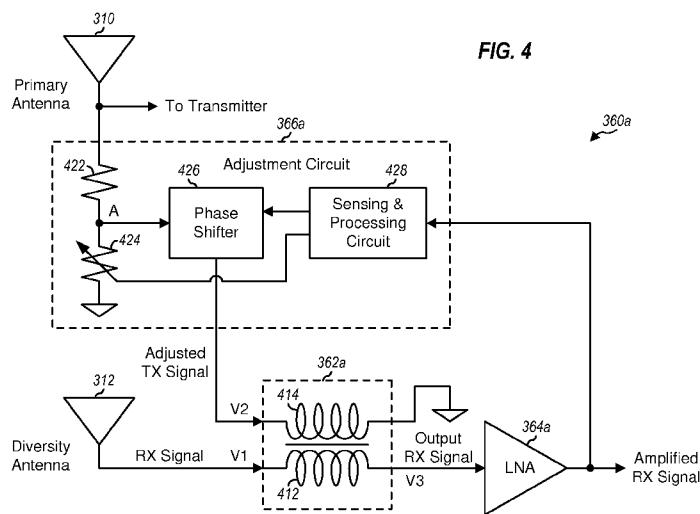


FIG. 4

(57) Abstract: A receiver with transmit (TX) signal cancellation is disclosed. In an exemplary design, an apparatus includes an adjustment circuit, a transformer (e.g., a balun), and a low noise amplifier (LNA). The adjustment circuit receives a version of a TX signal and provides an adjusted TX signal, which may have adjustable amplitude and/or phase. The transformer receives the adjusted TX signal and a receive (RX) signal including a leaked TX signal, attenuates the leaked TX signal in the RX signal based on the adjusted TX signal, and provides an output RX signal. The TX signal may be transmitted via a primary antenna, and the RX signal may be received via a diversity antenna. The LNA receives the output RX signal and provides an amplified RX signal. The adjustment circuit detects remaining TX signal in the amplified RX signal and adjusts the amplitude and/or phase of the adjusted TX signal to reduce the remaining TX signal.



WO 2012/158815 A3

INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2012/038172

A. CLASSIFICATION OF SUBJECT MATTER  
INV. H04B1/52  
ADD.  
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)  
H04B

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)  
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/009257 A1 (SAFARIAN AMINGHAEM [US] ET AL) 10 January 2008 (2008-01-10)	1,2, 8-11,15, 16,18, 19,22,23
Y	paragraphs [0047], [0057], [0067] - [0071]; figure 5	3-7, 12-14, 17,20,21
Y	----- WO 2005/050896 A2 (QUELLAN INC [US]; GEBARA EDWARD [US]; LASKAR JOY [US]; TENTZERIS EMMAN) 2 June 2005 (2005-06-02) page 23, line 23 - page 30, line 5; figure 8	3,4,17
Y	----- US 3 699 444 A (GHOSE RABINDRA N ET AL) 17 October 1972 (1972-10-17) column 5, line 1 - column 6, line 11; figures 1,3	5,12,20
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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
- "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  21 November 2012	Date of mailing of the international search report  30/11/2012
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Marques, Gabriela
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## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2012/038172

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 2009/213770 A1 (MU FENGHAO [SE]) 27 August 2009 (2009-08-27) paragraph [0023] - paragraph [0025]; figure 1 paragraph [0029] - paragraph [0032] paragraph [0052] - paragraph [0057]; figures 7,8 -----	6,7,13, 14,21

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/038172

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2008009257	A1	10-01-2008	US 2008009257 A1	10-01-2008
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			US 2009213770 A1	27-08-2009
			WO 2009106515 A1	03-09-2009
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**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 2, 8-11, 15, 16, 18, 19, 22, 23

leakage adjusting circuit using a transformer to insert  
signal corrections; amplitude and phase corrections

1.1. claims: 8-11, 18, 23

location of correction and feedback points

1.2. claim: 15

integrated circuit  
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2. claims: 3, 4, 17

mutual coupling between tx antenna and diversity antenna  
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3. claims: 5-7, 13, 20, 21

configurations of the transformer  
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4. claim: 12

extracting correction signal from tx signal  
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5. claim: 14

multi-band  
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2012/038172

## 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 additional 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 an 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.