Title: POWER AMPLIFIER WITH CLOSE-LOOP ADAPTIVE VOLTAGE SUPPLY

Abstract: A two- (or multi-) stage power amplifier receives a variable RF input signal, and outputs an optimized RF output signal from, for example, a mobile handset. The output power level from the handset is predetermined, as known in the art, by the received control signal from a base station. The first power amplifier stage amplifies the variable RF input signal and outputs an RF signal, Vin, to a power detector circuit and an RF signal to the second or next amplifier stage. The power detector circuit amplifies the Vin signal and rectifies that signal with a linearly biased diode and provides a detect signal to a DC to DC converter. The converter responds by providing an optimum voltage bias, which is linearly related to the DC voltage detect signal from the power detector, to the output stage, and, if desired, to the first and/or other stages of the power amplifier that optimizes the output power level while meeting the required linearity specification. The battery current consumption is optimized through this automatic, dynamically control of the supply voltage for the power amplifier at each output power level through the DC to DC converter.
INTERNATIONAL SEARCH REPORT

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both national classification and IPC:

INV: H03F 1/02

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H03F

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with Indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2005/285681 A1 (DOHERTY MARK [US] ET AL) 29 December 2005 (2005-12-29) paragraph [0040] - paragraph [0041]; figure 3</td>
<td>1, 2, 6, 7</td>
</tr>
</tbody>
</table>

Date of the actual completion of the international search

12 July 2007

Date of mailing of the international search report

21/09/2007

Name and mailing address of the ISA/

European Patent Office, P B 5818 Patentlaan 2 NL - 2280 HV Rijswijk
Tel (+31-70) 340-2040, Tx 31 651 epc nl
Fax (+31-70) 340-3016

Authorized officer

Kurzbauer, Werner
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>LARSON L ET AL: &quot;DEVICE AND CIRCUIT APPROACHES FOR IMPROVED WIRELESS COMMUNICATIONS TRANSMITTERS&quot; IEEE PERSONAL COMMUNICATIONS, IEEE COMMUNICATIONS SOCIETY, US, vol. 6, no. 5, October 1999 (1999-10), pages 18-23, XP000853481 ISSN: 1070-9916 page 21; figure 7</td>
<td>1,6</td>
</tr>
<tr>
<td>X</td>
<td>WO 00/07294 A (MOTOROLA INC [US]) 10 February 2000 (2000-02-10) page 4, line 6 - line 16; figures 1,3</td>
<td>1,6</td>
</tr>
<tr>
<td>X</td>
<td>WO 03/056698 A (KONINKL PHILIPS ELECTRONICS NV [NL]; GRILLO GIUSEPPE [NL]; VAN DE VEN) 10 July 2003 (2003-07-10) page 2, line 3 - line 10; figure 3</td>
<td>1,6</td>
</tr>
</tbody>
</table>
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 64(a).

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 fee, this Authority did not invite payment of any additional fee.

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.

see annex

Remark on Protest

- The additional search fees were accompanied by the applicant's protest
- No protest accompanied the payment of additional search fees
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1,2,6,7

An RF power amplifier system comprising a first and a second amplifier, an RF power detector, a DC to DC converter that receives the DC detect signal and outputs a corresponding supply voltage that is coupled to the second power amplifier and the DC voltage detect signal from the power detector is linearly related to the optimum supply voltage for the second power amplifier and the supply voltage is also coupled to the first power amplifier.

2. claims: 3,8

An RF power amplifier system comprising a first and a second amplifier, an RF power detector, a DC to DC converter that receives the DC detect signal and outputs a corresponding supply voltage that is coupled to the second power amplifier and the DC voltage detect signal from the power detector is linearly related to the optimum supply voltage for the second power amplifier and wherein the RF power detector includes a diode peak detector.

3. claims: 4,5,9,10

An RF power amplifier system comprising a first and a second amplifier, an RF power detector, a DC to DC converter that receives the DC detect signal and outputs a corresponding supply voltage that is coupled to the second power amplifier and the DC voltage detect signal from the power detector is linearly related to the optimum supply voltage for the second power amplifier and wherein the power amplifier system comprises a bypass switch for directly coupling the supply voltage to the amplifier.
### INTERNATIONAL SEARCH REPORT

<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 2002175764 A1</td>
<td>28-11-2002</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN 1672322 A</td>
<td>21-09-2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2005513943 T</td>
<td>12-05-2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2005151586 A1</td>
<td>14-07-2005</td>
</tr>
</tbody>
</table>

Form PCT/ISA/210 (patent family annex) (April 2005)