

EXHIBIT 6



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(12) **United States Patent**
Sorrells et al.

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(54) **APPARATUS, SYSTEM, AND METHOD FOR DOWN CONVERTING AND UP-CONVERTING ELECTROMAGNETIC SIGNALS**

(75) Inventors: **David F. Sorrells**, Middleburg, FL (US); **Michael J. Bultman**, Jacksonville, FL (US); **Robert W. Cook**, Switzerland, FL (US); **Richard C. Looke**, Jacksonville, FL (US); **Charley D. Moses, Jr.**, Jacksonville, FL (US); **Gregory S. Rawlins**, Heathrow, FL (US); **Michael W. Rawlins**, Lake Mary, FL (US)

(73) Assignee: **ParkerVision, Inc.**, Jacksonville, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
 This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/618,621**

(22) Filed: **Sep. 14, 2012**

(65) **Prior Publication Data**
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Related U.S. Application Data

(60) Continuation of application No. 12/876,356, filed on Sep. 7, 2010, now Pat. No. 8,295,800, which is a continuation of application No. 10/961,342, filed on Oct. 12, 2004, now Pat. No. 7,822,401, which is a division of application No. 09/855,851, filed on May 16, 2001, now Pat. No. 7,010,286, which is a continuation-in-part of application No. 09/550,644, filed on Apr. 14, 2000, now Pat. No. 7,515,896.

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(51) **Int. Cl.**
H04B 1/26 (2006.01)
H04B 15/00 (2006.01)

(52) **U.S. Cl.**
 USPC **455/313**; 455/323; 455/334; 455/318

(58) **Field of Classification Search**
 USPC 455/313, 323, 334, 318, 316, 319, 325, 455/333, 339, 340-341, 130, 197.2, 203, 455/262, 265, 284, 287, 326; 327/356-360
 See application file for complete search history.

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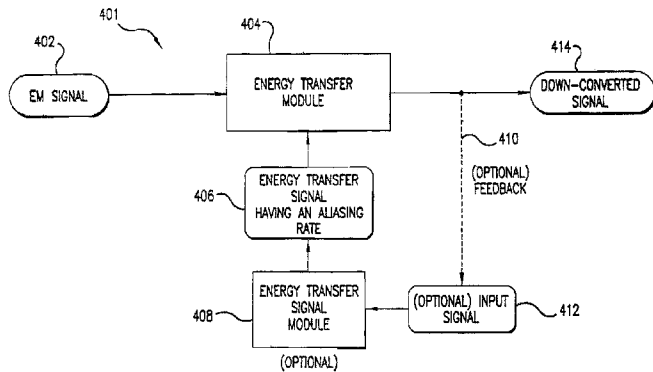
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Primary Examiner — Pablo Tran
 (74) *Attorney, Agent, or Firm* — Workman Nydegger

(57) **ABSTRACT**

Methods, systems, and apparatuses for down-converting and up-converting an electromagnetic signal. In embodiments, the invention operates by receiving an electromagnetic signal and recursively operating on approximate half cycles of a carrier signal. The recursive operations can be performed at a sub-harmonic rate of the carrier signal. The invention accumulates the results of the recursive operations and uses the accumulated results to form a down-converted signal. In embodiments, up-conversion is accomplished by controlling a switch with an oscillating signal, the frequency of the oscillating signal being selected as a sub-harmonic of the desired output frequency. When the invention is being used in the frequency modulation or phase modulation implementations, the oscillating signal is modulated by an information signal before it causes the switch to gate a bias signal. The output of the switch is filtered, and the desired harmonic is output.

41 Claims, 94 Drawing Sheets



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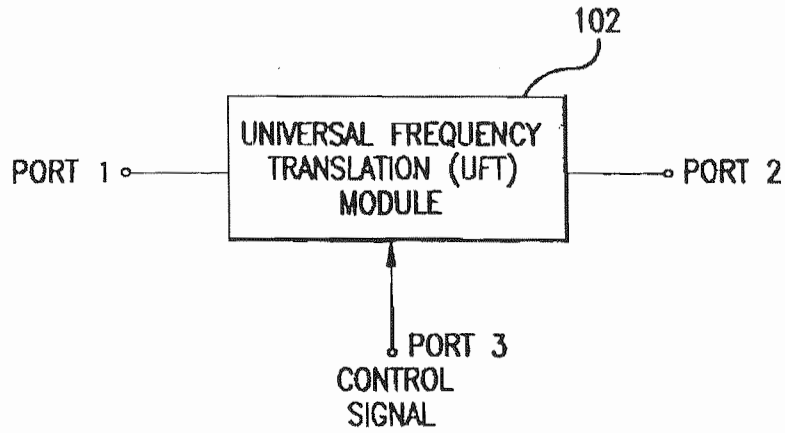


FIG. 1A

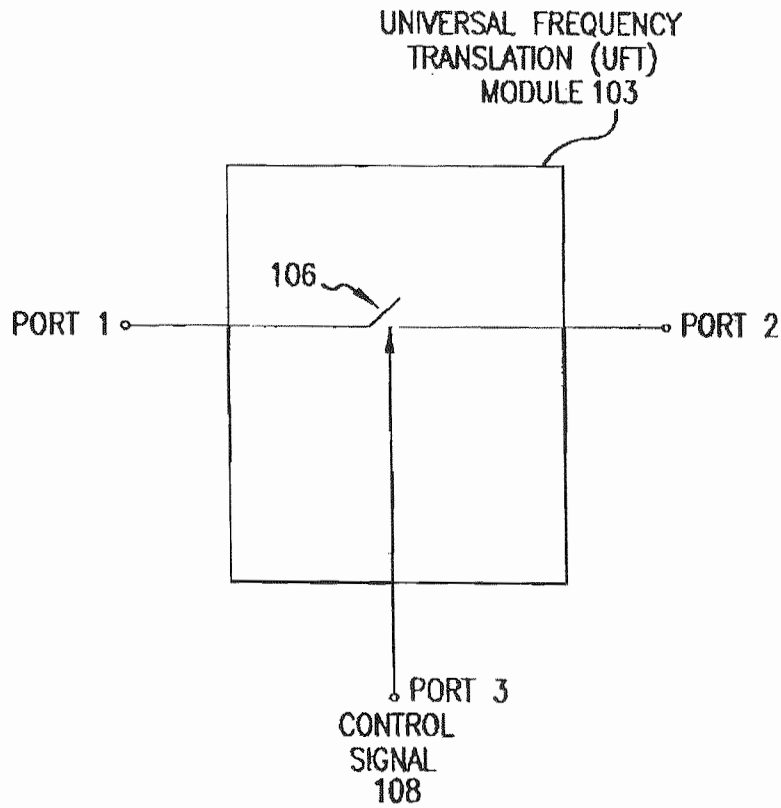


FIG. 1B

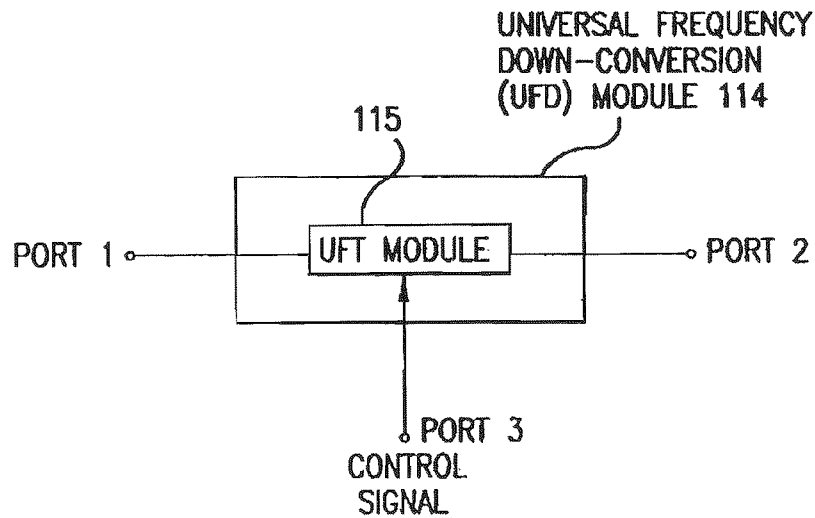


FIG. 1C

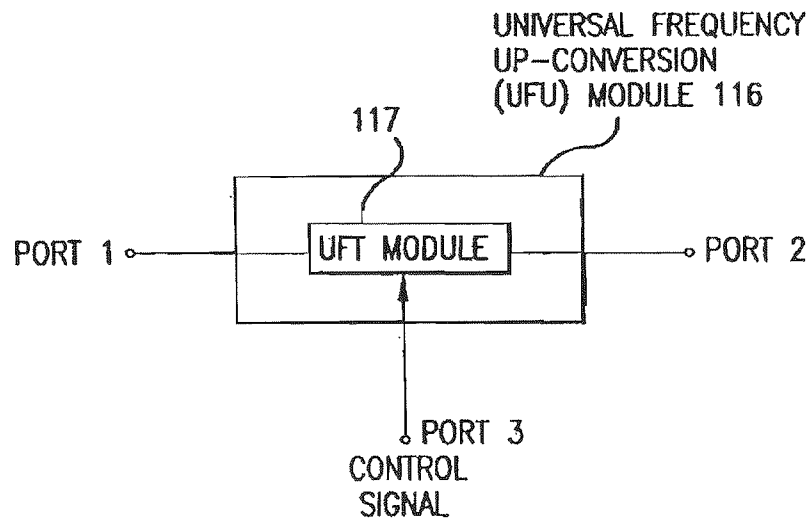


FIG. 1D

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