## **EXHIBIT 7**

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US008660513B2

## (12) United States Patent

#### Sorrells et al.

#### (54) METHOD AND SYSTEM FOR **DOWN-CONVERTING AN** ELECTROMAGNETIC SIGNAL, AND TRANSFORMS FOR SAME, AND APERTURE RELATIONSHIPS

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- (\*) 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.

- Appl. No.: 13/549,213 (21)
- (22)Filed: Jul. 13, 2012

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(60) Continuation of application No. 12/976,839, filed on Dec. 22, 2010, now Pat. No. 8,340,618, which is a continuation of application No. 12/349,802, filed on Jan. 7, 2009, now Pat. No. 7,865,177, which is a division of application No. 09/550,644, filed on Apr. 14, 2000, now Pat. No. 7,515,896, which is a continuation-in-part of application No. 09/293,342, filed on Apr. 16, 1999, now Pat. No. 6,687,493, which is a continuation-in-part of application No. 09/176,022, filed on Oct. 21, 1998, now Pat. No. 6.061.551.

#### US 8,660,513 B2 (10) **Patent No.:**

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- (52)U.S. Cl. USPC ...... 455/313; 455/113
- (58)**Field of Classification Search** USPC ...... 455/413, 113, 118, 130, 131, 182.1, 455/190.1, 191.1, 313, 323, 343, 350 See application file for complete search history.

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#### (57)ABSTRACT

Methods, systems, and apparatuses, and combinations and sub-combinations thereof, for down-converting an electromagnetic (EM) signal are described herein. Briefly stated, in embodiments the invention operates by receiving an EM signal and recursively operating on approximate half cycles (1/2,  $1\frac{1}{2}$ ,  $2\frac{1}{2}$ , etc) of the 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 an embodiment, the EM signal is downconverted to an intermediate frequency (IF) signal. In another embodiment, the EM signal is down-converted to a hasehand information signal. In another embodiment, the EM signal is a frequency modulated (FM) signal, which is down-converted to a non-FM signal, such as a phase modulated (PM) signal or an amplitude modulated (AM) signal.

#### 28 Claims, 284 Drawing Sheets



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