Abstract: A fast hopping frequency synthesizer (182) and transmitter (170) associated therewith. The frequency synthesizer and transmitter incorporates a digitally controlled oscillator (DCO) (188) to operate open loop. Instantaneous frequency switching is achieved by changing an oscillator tuning word (OTW) to imitate the three oscillators of a UWB transmitter. In one embodiment, the DCO can change the frequency instantaneously within 1/16 of the varactor devices used to construct the DCO. An all digital phase lock loop (ADPLL) (200) is used for offline calibration prior to the start of packet transmission or reception. Any phase shift during the switching is tracked by a digital circuit in the transmitter. In a second embodiment, additional frequency accuracy is provided by use of a numerically controlled oscillator (NCO) for generating a fine resolution complex exponential waveform which effectively shifts the synthesized frequency. A mixer applies the waveform to I and Q data samples.
A. CLASSIFICATION OF SUBJECT MATTER
   IPC: H03D 3/24
   USPC: 375/376
   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)
   U.S.: 375/376, 375, 373; 331/18, 25; 342/201, 202, 204; 708/276
   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)

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>
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</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 5,708,687 A (POWELL et al) 13 January 1998, figures 1 and 5; and col. 3, line 46 to</td>
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<td>col. 4, line 30, and col. 7, line 31 to col. 8, line 21.</td>
<td>9-10</td>
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<tr>
<td>Y</td>
<td>US 5,469,479 A (CHANG et al) 21 November 1995, figure 6, col. 4, line 59 to col. 5,</td>
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<tr>
<td></td>
<td>line 53.</td>
<td>1-8</td>
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<td>A</td>
<td>US 4,951,237 A (ESSENWANGER) 21 August 1990, figure 1, col. 4, line 25 to col. 5,</td>
<td>1-10</td>
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<td>line 28.</td>
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☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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