A 58-63.6GHz Quadrature PLL Frequency Synthesizer Using Dual-Injection Technique

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60GHz Communications

- 9 GHz unlicensed band at 60 GHz
- Several Gbps transfer rate speed
  - 3.5Gbps/ch (QPSK)
  - 7Gbps/ch (16QAM)

<table>
<thead>
<tr>
<th>Channel Number</th>
<th>Low Freq. (GHz)</th>
<th>Center Freq. (GHz)</th>
<th>High Freq. (GHz)</th>
<th>Nyquist BW (GHz)</th>
<th>Roll-Off Factor</th>
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</thead>
<tbody>
<tr>
<td>A1</td>
<td>57.24</td>
<td>58.32</td>
<td>59.40</td>
<td>1.76</td>
<td>0.25</td>
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<tr>
<td>A2</td>
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<td>60.48</td>
<td>61.56</td>
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<tr>
<td>A3</td>
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<td>62.64</td>
<td>63.72</td>
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<td>A4</td>
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<td>64.80</td>
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</table>

from IEEE802.15.3c-2009
Transceiver Architecture

• Direct conversion architecture for single chip implementation
  – Small area
  – Lower power consumption
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• Direct conversion architecture for single chip implementation
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Low phase noise -110dBc/Hz@10MHz

Wide tuning 57-66GHz

Low I/Q mismatch

Low power

Single chip implementation

LO Topologies

- **60GHz QPLL**
  - 9GHz tuning range
  - Low Q for capacitors
  - Poor Phase Noise

- **30GHz PLL**
  - 2\(^{nd}\) harmonic is utilized
  - Polyphase filter is used
  - High power consumption
  - I/Q mismatch
Proposed Architecture

• 20GHz PLL + Injection Locked Oscillator
  • Good tradeoff between phase noise & locking range
  • Tail feedback VCO [2]
  • Proposed dual Injection ILO

20GHz OSC  60GHz ILO

• 21dB improvement in phase noise (-96dBc/Hz@1MHz)
• 7Gbps wireless transfer rate using (16QAM)