Ka-Band Transmitter for Small Spacecraft

Smallsat Conference 2013
• Phase I Transmitter:
  – Ka-Band EESS Primary Band: 25.5 – 27.0 GHz
  – ½ watt RF Power Output (+27 dBm)
  – 23.0 dBiC Antenna
  – 50.0 dBm (20.0 dBW) EIRP
  – QPSK Modulator
  – Two CODING STEPS Taken from DVB-S2:
    • QPSK; R=1/4; LDPC Concatenated with BCH; Spectral Efficiency = 0.4902 bits/Hz
    • QPSK; R=9/10; LDPC Concatenated with BCH; Spectral Efficiency = 1.7886 bits/Hz
  – Supports 10 Mbps; 2.4 m GS Antenna with 99.5% Avail @ Svalbard; 600 km Orbit; 25 MHz Bandwidth
  – Supports 40 Mbps; 2.4 m GS Antenna under No-Rain Conditions @ Svalbard; 25 Mbps
  – 1.0 to 1.1 U Volume, including antenna
  – 10 watts DC Input Power
  – CCM Mode Only
• **Phase II Transmitter:**
  - Ka-Band EESS Primary Band: 25.5 – 27.0 GHz
  - ½ watt RF Power Output (+27 dBm)
  - 23.0 dBiC Antenna
  - 50.0 dBm (20.0 dBW) EIRP
  - Full DBV-S2 Modulator
  - Supports ALL Constant Envelope MODCODs from DVB-S2:
    - Supports 10 Mbps; 2.4 m GS Antenna with 99.5% Avail @ Svalbard
    - Supports 40 Mbps; 2.4 m GS Antenna under No-Rain Conditions @ Svalbard
  - 1.0 to 1.1 U Volume, including antenna
  - 15 watts DC Input Power
  - CCM, VCM and ACM are Possible
This is only to be used to show the DVB-S2 MODCOD table steps (in order of spectral efficiency). It is not to be taken as an optimized system approach. The grey highlighted rows are MODCOD steps that have a MINIMUM amplitude crest factor.

<table>
<thead>
<tr>
<th>Step Available</th>
<th>MODulation</th>
<th>CODing Rate</th>
<th>Es/No</th>
<th>Sym rate</th>
<th>BW (nyq)</th>
<th>C/No</th>
<th>C/N</th>
<th>Spectral Efficiency</th>
<th>Bits/ symbol</th>
<th>Data Rate</th>
<th>Eb/No</th>
<th>Eb/No</th>
<th>Gross Bit Rate</th>
<th>Info bits</th>
<th>code bits</th>
<th>&quot;overhead&quot;</th>
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<tbody>
<tr>
<td>1/4</td>
<td>QPSK</td>
<td>2.35</td>
<td>20.83</td>
<td>25.00</td>
<td>70.84</td>
<td>-3.14</td>
<td>0.490243</td>
<td>2</td>
<td>10.2134</td>
<td>0.746</td>
<td>-5.360</td>
<td>41.67</td>
<td>10.42</td>
<td>31.25</td>
<td>1.951%</td>
<td></td>
</tr>
<tr>
<td>1/3</td>
<td>QPSK</td>
<td>1.24</td>
<td>20.83</td>
<td>25.00</td>
<td>71.95</td>
<td>-2.03</td>
<td>0.656448</td>
<td>2</td>
<td>13.6760</td>
<td>0.588</td>
<td>-4.250</td>
<td>41.67</td>
<td>13.89</td>
<td>27.78</td>
<td>1.533%</td>
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<tr>
<td>2/5</td>
<td>QPSK</td>
<td>0.3</td>
<td>20.83</td>
<td>25.00</td>
<td>72.89</td>
<td>-1.09</td>
<td>0.789412</td>
<td>2</td>
<td>16.4461</td>
<td>0.727</td>
<td>-3.310</td>
<td>41.67</td>
<td>16.67</td>
<td>25.00</td>
<td>1.324%</td>
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<td>25.00</td>
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<td>0.21</td>
<td>0.988858</td>
<td>2</td>
<td>20.6012</td>
<td>1.049</td>
<td>-2.010</td>
<td>41.67</td>
<td>20.83</td>
<td>20.83</td>
<td>1.114%</td>
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<td>20.83</td>
<td>25.00</td>
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<td>1.183034</td>
<td>2</td>
<td>24.7563</td>
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<td>-0.790</td>
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<td>20.83</td>
<td>25.00</td>
<td>76.29</td>
<td>2.31</td>
<td>1.322253</td>
<td>2</td>
<td>27.5469</td>
<td>1.887</td>
<td>0.000</td>
<td>41.67</td>
<td>27.78</td>
<td>13.89</td>
<td>0.851%</td>
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<tr>
<td>3/4</td>
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<td>25.00</td>
<td>77.22</td>
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<td>2</td>
<td>30.9890</td>
<td>2.306</td>
<td>1.020</td>
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<td>31.25</td>
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<td>20.83</td>
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<td>1.587196</td>
<td>2</td>
<td>33.0866</td>
<td>2.674</td>
<td>1.670</td>
<td>41.67</td>
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<td>34.4721</td>
<td>2.993</td>
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<td>6.92</td>
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<td>6/7</td>
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<td>5.50</td>
<td>20.83</td>
<td>25.00</td>
<td>78.69</td>
<td>4.71</td>
<td>1.779910</td>
<td>3</td>
<td>37.0815</td>
<td>2.996</td>
<td>0.729</td>
<td>62.50</td>
<td>37.50</td>
<td>25.00</td>
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<td>5.41</td>
<td>1.760451</td>
<td>3</td>
<td>38.6011</td>
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<td>37.04</td>
<td>4.63</td>
<td>0.637%</td>
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<td>25.00</td>
<td>79.61</td>
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<td>37.6263</td>
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<td>4.17</td>
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<td>9/10</td>
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<td>20.83</td>
<td>25.00</td>
<td>81.10</td>
<td>7.12</td>
<td>2.228124</td>
<td>3</td>
<td>46.4193</td>
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<td>62.50</td>
<td>40.88</td>
<td>15.93</td>
<td>0.972%</td>
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</tr>
</tbody>
</table>

Canopus Systems US Proprietary Information
• Phase III Transmitter:
  – Ka-Band EESS Primary Band: 25.5 – 27.0 GHz
  – ½ to 1 watt RF Power Output (+27 to +30 dBm)
  – 23.0 dBiC Antenna
  – 50.0 dBm (20.0 dBW) EIRP to +53.0 dBm (23.0 dBW)
  – Full DBV-S2 Modulator
  – Supports ALL Constant Envelope MODCODs from DVB-S2:
  – Supports 125 Mbps Data Rate
  – 1.0 to 1.1 U Volume, including antenna
  – 14 watts DC Input Power
  – CCM, VCM and ACM; ACM Fully Supported
Progression of Ka-Tx Design

Phase I Transmitter
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