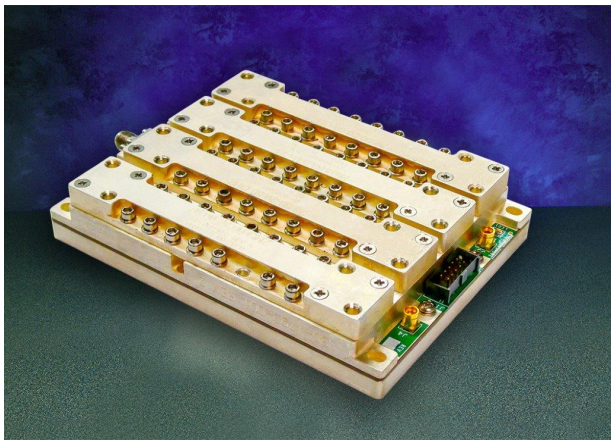
# LEO Requirements Drive Single, Dual, Tri and Quad-Band GaN Ka-band Block Upconverters in Incredibly Small Packages



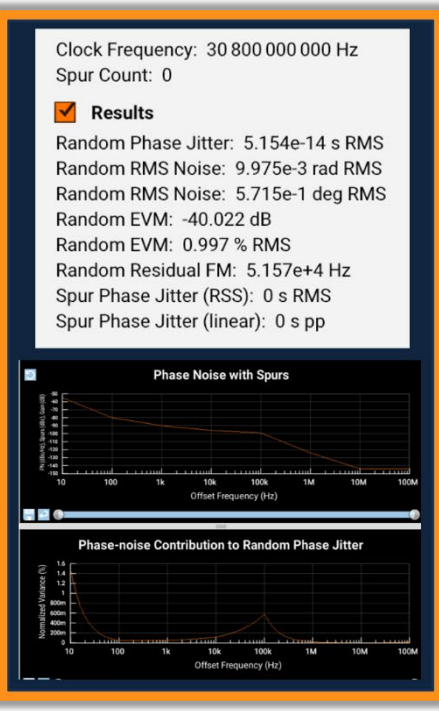
Recent industry focus is on non-GEO systems, including low-earth orbit (LEO) and medium-earth orbit (MEO) constellations that must launch 10's to 1000's of spacecraft to cover the globe with fast-moving satellites orbiting much nearer Earth's surface than GEOs. These LEO systems cost more to launch and maintain than GEO with shorter lifetimes and many more gateways, but much lower latency. LEO systems with intersatellite crosslinks (ISLs) have a big advantage in fewer "hops" for low latency and higher network efficiency. They're also advantaged for aero and marine mobility markets and produce massive network capacity – 20+ Tbps by 2030. SpaceX's Starlink, OneWeb, Telesat's Lightspeed, Amazon's Kuiper, and SES's mPower are all proceeding with satellite procurement and ground terminal development, each pushing the limits of possibility for an efficiency/cost edge.

Complex, higher-order modulation and coding used to maximize spectral efficiency and drive down system cost/bit demand pretty dramatic tightening of RF component requirements including lower phase noise, phase jitter, error vector magnitude (EVM), and gain variation for SSPA/BUCs all while radically driving down cost with high volume given the large number of gateways and very large number of users.

**Single-Sideband Phase Noise (dBc/Hz)**

| Frequency Offset | IESS | w/ 10MHz Reference | w/ 10MHz Reference and X5 Multiplier | w/ 100MHz OCXO Reference | 100 MHz OCXO Improvement over 10 MHz | 100 MHz OCXO Improvement over 10 MHz and X5 Multipler |
|---|---|---|---|---|---|---|
| 10Hz | -30 | -46 | -50 | -62 | 16dB | 8dB |
| 100Hz | -60 | -68 | -75 | -81 | 13dB | 6dB |
| 1kHz | -70 | -80 | -82 | -93 | 13dB | 11dB |
| 10kHz | -80 | -90 | -85 | -97 | 7dB | 12dB |
| 100kHz | -90 | -96 | -95 | -101 | 5dB | 6dB |
| 1MHz | | -120 | -123 | -132 | 12dB | 9dB |
| 10MHz | | -126 | -123 | -143 | 13dB | 20dB |

| Parameter | | 10 MHz reference with X5 multiplier | 100MHz low phase noise OCXO | 100 MHz OCXO Improvement | 100 MHz OCXO % Improvement |
|---|---|---|---|---|---|
| Random Phase Jitter | sec RMS | 1.10E-13 | 8.42E-14 | 2.56E-14 | 23% |
| Random RMS Noise | rad RMS | 0.0200 | 0.0153 | 0.0047 | 23% |
| Random RMS Noise | deg RMS | 1.146 | 0.879 | 0.267 | 23% |
| Random EVM | dB | -33.975 | -36.286 | 2.311 | - |
| Random EVM | % RMS | 2.001 | 1.534 | 0.467 | 23% |
| Random Residual FM | Hz | 1.15E+05 | 8.17E+04 | 3.37E+04 | 29% |




*LEO Ka Systems Need SSPA/BUCs with Better Phase Noise, Jitter and EVM Performance to Meet Spectral Efficiency Goals*

Contact Xicom for technical information. info@xicomtech.com