# SmallSat Booming Growth Realized with Cost-effective COTS in Space

## Trends in Next-gen Space Applications

Up to 20,000 satellites may be launched over the next decade, the majority in LEO and NEO orbits that require less radiation tolerance than long-term, deep space missions. COTS space electronics are driving this space boom by providing affordable, risk-mitigated solutions for these application environments.

## Using Cost-effective COTS

Traditional space applications have mandated expensive and time-consuming levels of component testing, but new applications geared towards short duration and LEO/NEO environments require less validation. For example, COTS-based low-orbit satellite clusters and constellations, versus one large unit, reduce risk by eliminating a single point of failure, distributing reliability across multiple smaller units.

### Series-300 vs. Series 500 Level Parameters

| Parameter | SERIES 500 Flight: Beyond LEO | NEW: SERIES 300 Flight: NEO & LEO |
|---|---|---|
| **Cooling Method** | Conduction[1] | Conduction |
| **Temperature (°C)**<br>Storage<br>Operating | (In vacuum)<br>-62°C to +125°C<br>-40°C to + 65°C | (In vacuum)<br>-62°C to +125°C<br>-40°C to + 65°C |
| **Vibration (3 axes)**<br>Random (Freq)<br>Sine (Freq) | <br>0.01g (0-2000Hz)<br>10g (50-500Hz) | <br>0.01g (0-2000Hz)<br>10g (50-500Hz) |
| **Shock (3 axes)**<br>Half Sine G (duration)<br>Saw Tooth G (duration) | <br>40g (11ms)<br>1000g (6ms) | <br>40g (11ms)<br>1000g (6ms) [SRS] |
| **Altitude (ft)**<br>Operating Max | <br>$10^{-4}$ Torr | <br>$10^{-3}$ Torr |
| **Relative Humidity**<br>Operating | <br>0-100% | <br>0-100% |
| **Conformal Coating** | Urethane | Arathane 5750 |
| **Part Selection** | EEE-INST-002 Level 2 or higher by lot | COTS with no screening |
| **Radiation Tolerance**<br>TID<br>Latch up immunity<br>SEU rate [ISS Orbit] | <br>> 25 krad (Si)<br>≥ 37 MeV-cm²/mg<br>One Type-2 SEFI per 1,200 days at ISS orbit | <br>< 15 krad (Si)<br>Mitigated<br>One Type-2 SEFI per 60 days at ISS orbit |

*1 Conduction-cooled per ANSI/VITA 30.1 - 2008 3U cPCI Mechanical Format Factor, Conduction-cooled PMCs: per ANSI/VITA 20-2001 (R2005)*

## A New Standard: Series 300 Qualification

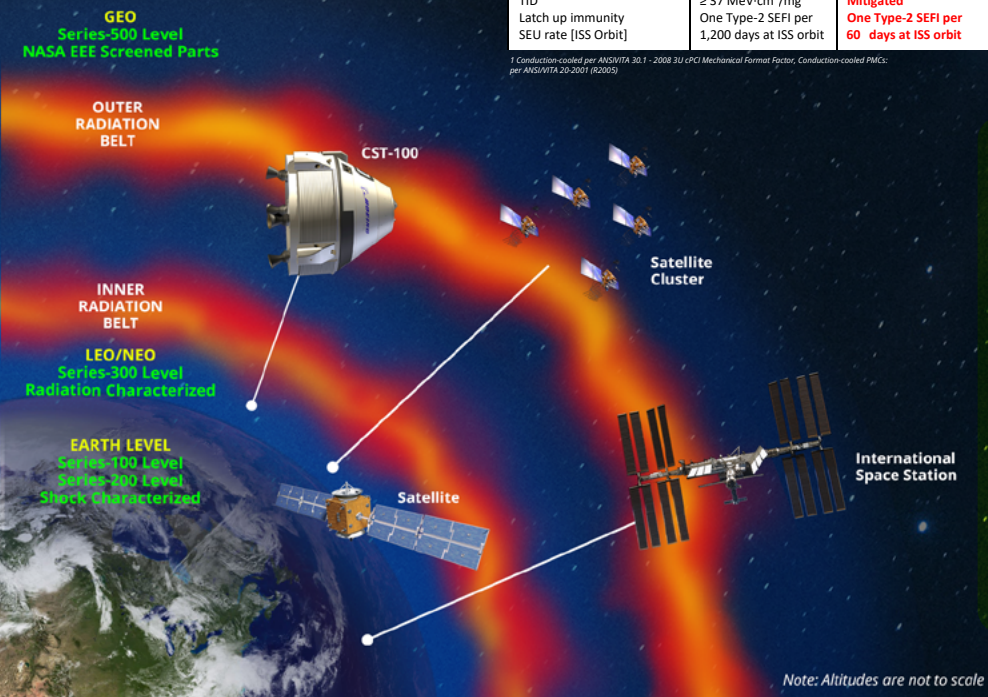
Using COTS in space is now a necessity to meet cost, time to market and integration requirements. A newly established Series 300 qualification for space components provides a standardized infrastructure to validate COTS-based components deployed in LEO and NEO space applications. This is a shift from costly Series 500 level components, fully tested to NASA EEE qualifications.

*Lower radiation requirements and COTS part selection reduce Series-300 component cost and time to market*

## Advanced Technologies: AI & Rugged GPGPU

The reality of cost-effective, radiation characterized COTS paves the way for technology innovations in space, most notably artificial intelligence (AI) through rugged GPGPU-based parallel processing, which enables the processing of tens of thousands of data points simultaneously, versus only hundreds using serial processing. Space applications can now manage multiple streams of high definition graphics, while effectively reducing latency to achieve near-real-time processing through this parallel computing architecture.

*Aitech's A176 Small Form Factor (SFF) AI GPGPU supercomputer with a NVIDIA® Jetson™ System-On-Module will be used for video processing and data recording on NASA's LOFTID.*




*Note: Altitudes are not to scale*

## Real-world Examples: COTS in Space

"COTS in Space" is not a new concept. Aitech has been providing reliable COTS-based systems to the space industry for more than three decades. What is new, is the ability to better integrate COTS electronics into higher density, more compact systems throughout LEO & NEO applications.

**Virgin Galactic:** Space tourism is making significant strides, most recently with the 200th flight plan and successful demonstration of the SpaceShipTwo spaceplane that reached its targeted altitude and resolution. Aitech provided the rocket motor controller (RMC) unit for this spaceplane.

**NASA LOFTID:** For this mission planned for 2022, an Aitech GPGPU-based system will collect video data and telemetry and transmit it to ground-based stations or spaceborne assets for near real-time monitoring of the entire re-entry, with much of the computing decisions made on-board to achieve autonomous mission success.