# DEFIANT Specifications

| Spacecraft Performance Metrics | |
|---|---|
| Core Spacecraft Dry Mass | 11-41 kg |
| Payload Mass | 7-30 kg |
| Propellant Mass (option) | Up to 5 kg |
| Total Observatory (Wet) Mass | 20-50 kg |
| Spacecraft Dimensions (Stowed, customizable) | 0.30 m x 0.30 m x 0.38 m (light)<br>0.30 m x 0.30 m x 0.45 m (typical)<br>0.48 m x 0.48 m x 0.60 m (heavy) |
| Payload Envelope | 0.30 m x 0.30 m x 0.13 m (light)<br>0.30 m x 0.30 m x 0.15 m (typical)<br>0.48 m x 0.48 m x 0.20 m (heavy) |
| Peak Power Generation (end-of-life) | 58-256 W |
| Processing Speed | 40-300 MHz (housekeeping and attitude control)<br>500 MHz to 1.2 GHz (payload computer option) |
| Data Interface | Customizable (serial, I2C, SPI, GPIO, CAN, LVDS, others) |
| Data Storage | 2 GB (housekeeping and attitude control)<br>Up to 256 GB (payload computer option) |
| Encryption (option) | AES-256-GCM Commercial Encryption |
| Telemetry & Command Data Rates | 4 or 32 kbps (uplink)<br>32 kbps to 2 Mbps (downlink, variable) |
| Payload Downlink (option) | 50 to 400 Mbps |
| Attitude Control Architecture | Customizable (inertial, nadir, tracking (ground, sun, limb, etc)) |
| Attitude Determination | 10 arcsec (2σ, inertial) |
| Attitude Control | 17 arcsec (2σ, inertial) |
| Attitude Stability | 2-60 arcsec in 90 seconds (2σ) |
| Positional Accuracy | 10 m |
| Pointing Agility | 1-5 deg/s |
| Total Impulse (option) | Up to 7400 Ns |
| Design Life | 1-3 years |
| **Spacecraft Design Characteristics** | |
| Bus Architecture | Single string |
| Structure Type | Aluminum frame with honeycomb panels |
| Primary Power Generation | Body mounted ATJ solar cells<br>Two solar wings (up to 3 segments each) |
| Battery | Li-Ion 3s3p to 3s4p battery pack, 13-19 A·h |
| Bus Voltage | 12 V unregulated; 3.3V, 5V regulated |
| Command and Data Handling | OBC-302 or OBC-400 (housekeeping and attitude control)<br>OBC-302, OBC-400, or Q8 (payload computer option) |
| Communications | Telemetry and Command: S-band (X, K options)<br>Payload Data: X-band (option) |
| Attitude Determination | 3-axis; 1-2 star tracker(s), 6x sun sensor, rate sensor or FOG, magnetometer |
| Attitude Control | 3-axis; 4x reaction wheels (60mNms),<br>3x magnetorquers or reaction control system |
| Position Determination | NORAD TLEs, GPS receiver |
| Propulsion (option) | Warm Gas (Resistojet), Monopropellant, or Field Emissions Electric Propulsion (option) |
| Thermal | Customizable approaches (passive, heaters, heat pipes, switches, radiator, etc.) |
| Launch Vehicle Compatibility | Any launch vehicle, including Soyuz, PSLV, Vega, Falcon 9, Electron, LauncherOne, others |
| Heritage | HawkEye 360, NorSat-4, NorSat-TD, Gray Jay, Aspera (Core Technologies TRL 9) |
| Baseline Delivery | ARO through on-orbit checkout: 18-24 months |
| Facilities | Fully equipped facilities including: analysis, design, simulation, soldering stations, visual and X-ray inspection stations, AIT lab, Class 10,000 cleanroom, thermal vacuum chambers, vibration table, anechoic chamber, thermal chambers, test racks, electronics test equipment, mission control center, ground station. Access to David Florida Laboratory for larger spacecraft. |

The SFL DEFIANT platform is capable of supporting missions ranging from 20-50kg. It has a modular design that allows for flexibility, configurability and scalability. The platform includes a standard suite of hardware for housekeeping, telemetry and command (T&C), power management, and attitude control. The platform is configured with body mounted solar cells, two deployable solar wings, and a battery pack to support the payload (instrument) power profile. The platform can be augmented with options, including but not limited to encryption/decryption module, dual star trackers, payload computer, payload X-band transmitter, and a propulsion system. The on-board computers in the command and data handling subsystem can be upgraded to higher processing power and data storage if needed. A reaction control system can be substituted for magnetorquers for higher orbits.

The system architecture for the spacecraft employs a single-string design that results in a low mass, low cost spacecraft. Power enters the system from the body mounted solar panels and solar wings through the Modular Power System (MPS). The MPS includes a Solar Array / Battery Regulator (SABR) module, which provides peak power tracking at the individual string level to optimize power generation and steps down the solar array voltage to the battery level. The MPS also provides power conditioning and switching, distributing unregulated 12 V, regulated 5 V, and regulated 3.3 V power to the spacecraft hardware.

For command and data handling, the On-Board Computers (OBCs) are central to the architecture and support a variety of serial communications protocols in order to interface with all of the spacecraft hardware. One of the OBCs is designated the Housekeeping Computer (HKC) and is responsible for collecting spacecraft telemetry, routing information to and from the radio links, and configuring the payload. The other OBC is a dedicated Attitude Determination and Control Computer (ADCC) used to query the attitude sensors, run attitude control algorithms, and command the attitude actuators. A payload computer can be added as an option to manage an optional X-band payload transmitter and to provide special connectivity, processing and storage for the payload.

An S-band command receiver is included with either a 4kbps or 32kbps data rate. An S-band telemetry transmitter is provided with variable data rate ranging from 32kbps to 2Mbps. Converters can be added to the receiver and transmitter if communication is desired in X, Ku, or Ka bands. As an option, an X-band transmitter may be added for payload downlink with data rate ranging from 50Mbps to 400 Mbps. Patch antennas, patch arrays and horns may be used as payload downlink antennas.

An Encryption/Decryption Module (EDM) may be added as an option to provide additional security in communication. The EDM uses the AES-256/GCM (Advanced Encryption Standard 256 Galois Counter/Mode) commercial encryption standard.

The attitude control system uses a sensor suite of sun sensors, a magnetometer, a rate sensor and a star tracker. A second star tracker may be added as an option for improved attitude determination performance. The rate sensor or fiber optic gyro is used for rotation rate sensing depending on the performance requirements. Four reaction wheels are used along with three magnetorquers. For higher orbits, a cold-gas reaction control system can be substituted for the magnetorquers. Various pointing modes are possible: inertial, nadir, target tracking, limb pointing, and sun pointing to name a few. Peak slew rates range from 1-5 deg/s depending on the final inertias of the Observatory. SFL's attitude control system is highly developed and mature. A GPS receiver is included for accurate position determination and to support formation determination and control if multiple spacecraft are to be used in tandem.

A propulsion option is available for initial orbit phasing, stationkeeping, collision avoidance and deorbiting. The platform is compatible with a wide variety of propulsion systems.

DEFIANT can accommodate a variety of payload sizes ranging from 7 to 30kg. Roughly one third of the internal volume of the spacecraft is dedicated to payload. External surface area can be provided for apertures, antennas, and radiators as necessary to support payload function.

The data and power connections can be altered or customized to meet the needs of the mission. DEFIANT is a flexible, customizable, and scalable core spacecraft that can accommodate a wide variety of small microspacecraft missions ranging in total Observatory mass between 20-50kg.

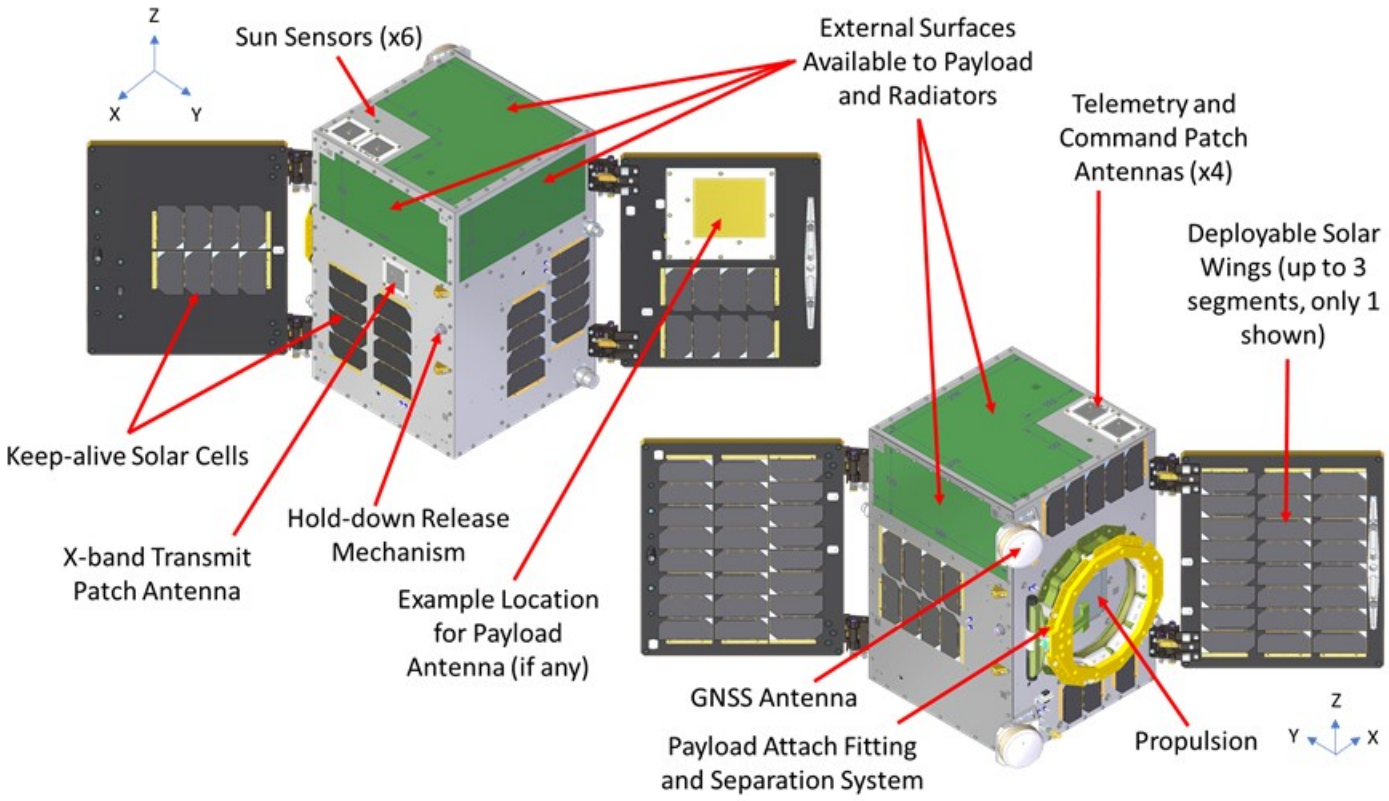


**Figure 1: Spacecraft Exterior Layout**

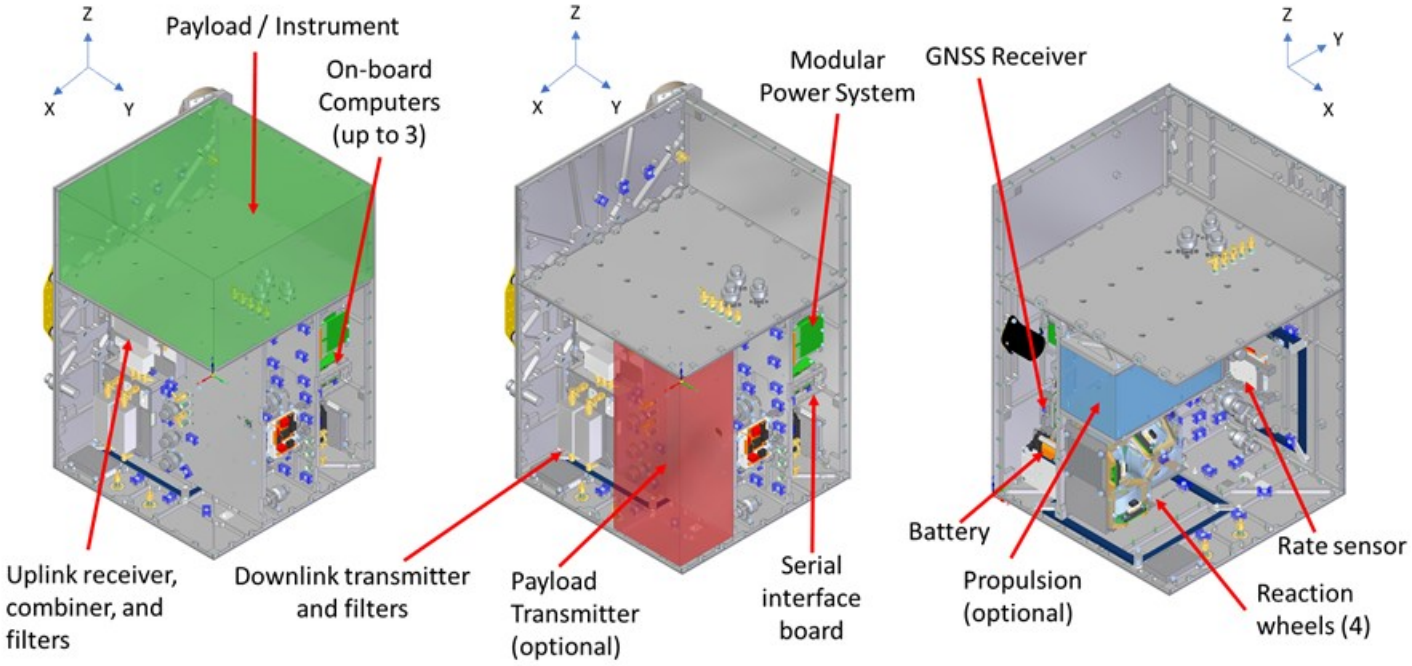


**Figure 2: Simplified Interior Layout**


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