# CanSat Kit

## Project-based Educational Engineering System

**Company Overview:** **Twiggs Space Lab, LLC** ("**TSL**") is focused on creating STEAM based products and curricula to stimulate, engage, and encourage students to pursue interests in science, technology, engineering, arts, and math. Our company's mission is to inspire future generations of engineers and scientists to make the world a better place through innovative research in space. The CanSat Kit ("**CSK**") includes the hardware, software, and curricula necessary to provide students a challenging, project-based, hands-on experience in the life cycle development of a satellite project by building, testing and operating a CanSat.

**CanSat:** A CanSat functions as a simulation of a real satellite, integrated within the volume and shape of a soft drink can. The CanSat is based on a concept and standard first proposed in November 1998, by Robert Twiggs, during the first "University Space Systems Symposium" in Hawaii. During his presentation, Prof. Twiggs formerly at Stanford University Space Development Laboratory, announced to the audience that "we should build a satellite in a Coke can and get it launched into space." Later that year, Prof. Twiggs together with his colleagues in industry and at other universities worldwide, began a cooperative program called ARLISS (www.arliss.org), to sponsor an event to launch CanSats from a dry lakebed in the Black Rock Desert of Nevada.

**CanSat Kit:** The CanSat Kit ("**CSK**") is an exciting and challenging project-based educational engineering system for students to acquire hands-on training in the life cycle development of a basic satellite project at an affordable price. Critical skills learned, include mission planning and design, building and testing satellite subsystems, systems engineering, project management, remote sensing and data analytics, and many other competences required for the development and management of new technologies. The CanSat may be launched to an altitude of a few hundred meters by a rocket, dropped from a drone, plane or captive balloon. Once deployed, the CanSat mission begins to carry out a scientific experiment and collect data.

**CSK:** The CSK includes all the boards, parts, and electronic components required to build a CanSat, a detailed User's Manual for assembly, testing and operations, and software libraries. CSK is comprised of five subsystems: (1) Command and Data Handling ("**CDH**"); (2) Electrical Power Subsystem ("**EPS**"); (3) Attitude Determination Subsystem ("**ADS**"); (4) Communication Subsystem ("**COM**"); and (5) Proto Board ("**PRT**"). Students solder all components on each board. See ***Figure 1*** for a fully assembled CSK.

Figure 1 Fully Assembled CSK

**CDH:** Command and Data Handling Subsystem ("**CDH**") processes the information relating to health, safety, and status of the satellite as well as the rest of the subsystems. It receives, processes, and transmits data among the several satellite subsystems and can store data on-board. Some of the primary features of the CSK-CDH shown in ***Figure 2***, include: Seeeduino XIAO microcontroller, EEPROM ($I^2C$), Micro SD card, and reset button.

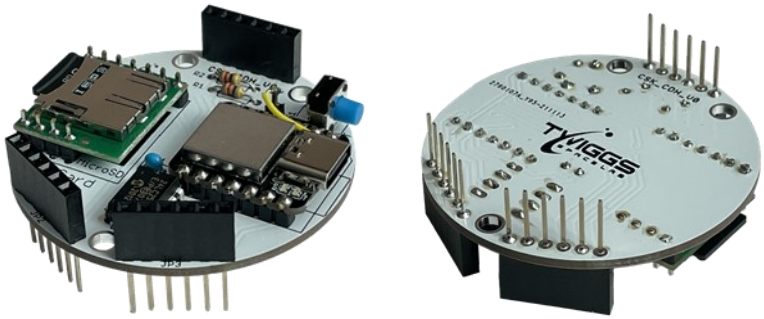

Figure 2 CDH Top and Bottom View

Figure 3 BPA

**BPA:** Bottom Plate Adapter ("**BPA**") shown in ***Figure 3***, is the mechanical interface between the satellite and the launch vehicle. In the CSK, the BPA functions as the interface to the soda Can container and the CSK Subsystems.

**EPS:** The Electrical Power Subsystem ("**EPS**") on a satellite generates, stores, conditions and distributes electrical power as necessary to enable the satellite to fulfill the mission requirements during all phases and expected modes of operation. The CSK-EPS has the function to store and distribute a regulated voltage to the CSK Subsystems. Some of the primary features of the CSK-EPS shown in ***Figure 4***, include: solar panel input 4.4-6V; max charge current 500mA; interface: 2-pin JST connectors (or PH2.0 ); short circuit protection; continuous charge current up to 500mA; battery status indication LEDs; and support battery charge through a USB.

Figure 4 EPS Top and Bottom View

**ADS:** The Attitude Determination Subsystem ("**ADS**") defines a satellite's orientation in space. The primary function of the ADS is to provide information to the Attitude Control Subsystem ("**ACS**") to keep the satellite pointed in the right direction. The CSK-ADS Module includes a Temperature Sensor that can be used as Thermal Determination System. Some of the primary features of the CSK-ADS shown in ***Figure 5,*** include: 3-axis accelerometer and 3-axis gyroscope; 3-axis magnetometer; barometric pressure and temperature sensor, and analog sun sensor.

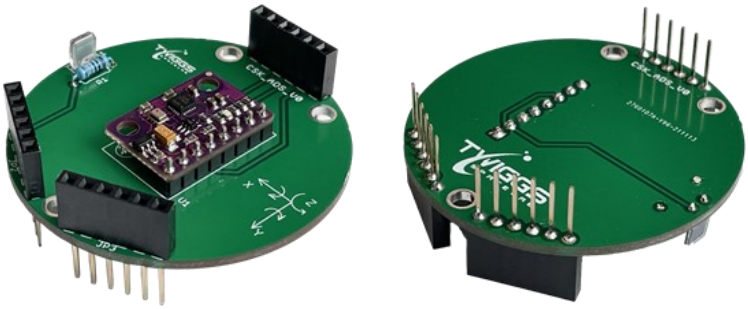

Figure 5 ADS Top and Bottom View

**COM:** The Communication Subsystem ("**COM**") (commonly referred to as the Telemetry, Tracking & Command Subsystem ("**TT&C**") for the spacecraft) provides the conditioning, transmission, reception, spacecraft health telemetry and some mission data signals. The CSK-COM provides an Xbee socket in which the appropriate transceiver can be attached. The default module provided is a Bluetooth. Some of the primary features of the CSK-COM shown in ***Figure 6,*** include: Xbee socket to use multiple communications modules; two monitoring LEDs; OLED display (shown); and optional GPS.

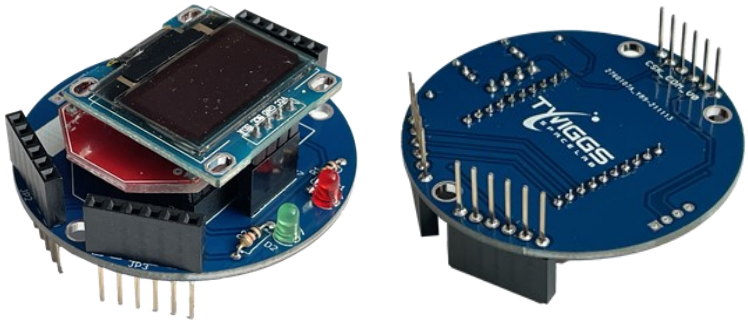

Figure 6 COM Top and Bottom View

**PRT:** The ("**PRT**") is a board designed to implement customized payloads. The payload is the subsystem required to meet the objectives of the satellite mission. The size and specification of the satellite are driven by the payload requirements. Some of the primary features of the CSK-PRT shown in ***Figure 7***, include: bus signals pads; 3.3V pads line; GND pads line; and bus connectors.

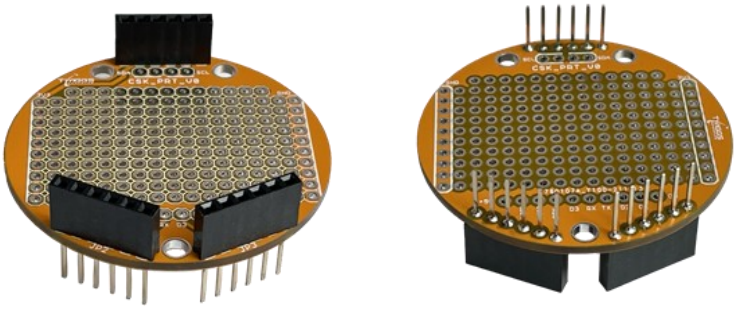

Figure 7 PRT Top and Bottom View

**About Us:** ***Twiggs Space Lab, LLC*** was founded by Professor Bob Twiggs and Matt Craft to develop inspirational STEAM based products with an emphasis on systems engineering and space technologies. Professor Twiggs is the co-inventor of the CubeSat and inventor of the PocketQube and CanSat. In 2010 he was selected by the Space News publication as one of 10 space professionals "That Made a Difference in Space." TSL's products and programs help prepare students for exciting careers in Space 2.0 and other STEM careers.

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