A UAS operator located in the Ground Control Station (GCS) controls the UA, continually monitoring system status, and maneuvers the UA as desired. The downlink data includes a display of health and status parameters such attitude, magnetic heading, indicated airspeed, GPS position, barometric altitude, rate of climb, engine instrumentation, and warnings and cautions. UA position is displayed onto a high-resolution digital map within the GCS. The primary and backup links have a line of sight operational range. Both links incorporate error detection to ensure that erroneous interference is not processed by the avionics. Two separate up-link frequency bands and a directional antenna are incorporated to minimize communication link issues due to interference.

The antenna system is comprised of five antennas, or six antennas if equipped with CRP: a dual element antenna for primary uplink/downlink and video downlink, a TALS antenna, a UHF antenna for backup uplink/downlink, and a Global Positioning System (GPS) antenna.

Signal Destination	Signal Name	Frequency Range
1	Primary Up/Down Link Video Down Link	2.400 to 2.485 GHz 4.400 to 4.950 GHz
2	Tactical Automatic Landing System (TALS)	34.93 to 35.00 GHz
3	UHF Secondary Up/Down Link	340 to 400 MHz
4	Global Positioning System (GPS)	Provided By Satellite
5	Identify Friend or Foe (IFF)	Receives on 1030 MHz Replies on 1090 MHz
6	SINCGARS Communications Relay Payload (CRP)	30 to 80 MHz

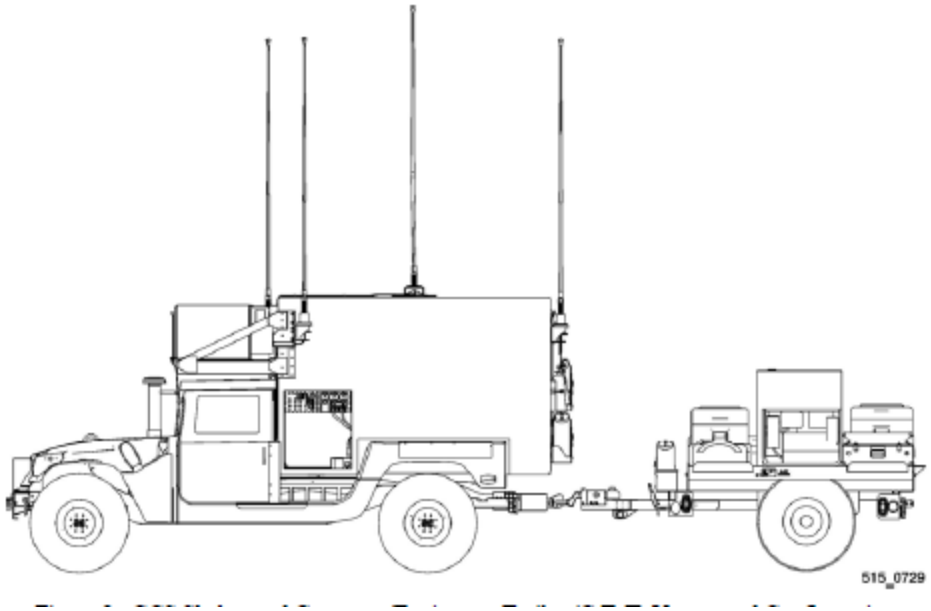
Under certain AV failure conditions, the AV can autonomously command parachute deployment. These autonomous flight terminations are intended to preclude a catastrophic flight process failure from leading to the AV exiting an area without possibility of AVO intervention, or an autonomous termination on loss of both uplinks and loss of engine and impending ground contact.

The AVO and MPO perform their operations from the GCS console. The console is located at the base of the GCS Workstation. It contains the joysticks, keyboards, and audio controls by which the AVO and MPO command the functions necessary to control the Air Vehicle and Payload, and to disseminate the video and C4I messaging throughout the TOC. The console is split into two identical stations, the left station, typically the AVO, and the right station, typically the MPO. Each station consists of a dedicated monitor, keyboard and a joystick. The Center Flat Panel Display (CFPD) is shared by the two operators.

Three 20.1” monitors provide the primary display to the AVO, and MPO. The monitors are MIL-tailored, rugged flat panel displays with at least a 70° viewing angle. They accept graphics (VGA) signals. AVO and MPO images are keyed to their respective monitors. Images displayed on the CFPD are switchable between the AVO, MPO and SmartCam. Switching is accomplished by a six position rotary switch.

The AVO/MPO keyboards resemble a standard keyboard. It is the operational interface between the AVO/MPO, GCS equipment, and other operational equipment. There are twelve hot keys at the top of the keyboard. These keys are preset to execute key AVO/MPO functions at the workstation. To the right of the keyboard, is the trackball. The trackball allows the AVO/MPO to move the cursor on the designated monitor. Four rubber protected pushbuttons function as a mouse. The topmost button is not functional for Shadow 200 TUAV. The remaining three buttons are multifunctional dependant up what screen/mode is being used.

The joystick is the primary means of controlling the payload. It consists of a stick that can rotate around two axes of motion (fore and aft / side to side), with a rotating cap on top. The stick motion commands the payload slew. Forward stick motion (pushing the stick) causes the Payload to slew down (with respect to the airframe), while aft stick motion (pulling on the stick) causes the Payload to slew up. The cap on the top of the joystick can rotate around the axis of the stick. By rotating this cap, the MPO can command the payload Field Of View (FOV). The cap on the top of joystick can rotate around the axis of the stick. The four-position toggle switch to left of the hot keys also controls the zoom function. To zoom in on a target, the MPO either pushes the toggle up or turns the cap clockwise; to zoom out, the MPO either pushed the toggle down or turns the cap counterclockwise. A placard is provided to identify the function of joystick controls. Unlike joysticks that use mechanical means to translate joystick deflection to potentiometers or permanent magnet based controllers, the Solid State Inductive Joystick has no moving electrical parts. This difference results in a joystick controller with no mechanical wear and no signal drift due to the fluctuation of magnets over time. Further, due to the electronically controlled excitation coil, output signals are unaffected by high frequency noise. The solid state inductive joystick uses an electronically controlled excitation coil and four discrete sensing coils that report the position of the joystick to the amplifying and signal conditioning electronics. The signal from the four sensing coils are monitored and an output analog voltage signal is generated, amplified and buffered to be compatible with external electronic circuitry. Four buttons on the joystick control the payload.



VCS (Vehicle Control System)

The Vehicle Control System (VCS) main window is the primary operator interface for the Shadow TUAV ground station. This work package will describe the functions available in this window. A scrolling map of the TUAV mission area displays as a background within the VCS main window and shows geographic, AV and TUAV mission specific information. Maps of any operating area can be loaded to VCS from National Imagery and Mapping Agency (NIMA) data and stored by the workstation computer. When VCS starts, the main window opens with no map displayed. The operator chooses a map already loaded, loads a map or chooses a reference grid display if map information is not available.

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GDT Icon with Wind Vector -The VCS software will display a ground wind vector on the map display when a weather station is present. The wind direction is displayed by an arrow added to the GDT symbol and the wind magnitude is displayed as text under the GDT symbol as shown above. The ground wind display can be removed from the map display using the map Overlay pull-down menu. The map Overlay pull-down menu also supports turning on and off (decluttering) the Flight plan leg text boxes on the map display. Should the downlink from the weather application fail after previously establishing a connection, the vector will appear in orange.

AV Control Panel

The Air Vehicle (AV) Control Panel transmits commands and messages to the AV and displays the status from the AV. Downlink from the AV is displayed in green, data from the GDT is displayed in cyan, and data from the TALS is displayed in a darker green shade. Each of these colors fades to orange if there is no downlink from the respective unit (AV, TALS, and/or GDT). This same convention is used throughout the Vehicle Control Station (VCS) software panels. All dialogs which send or request AV information have a status display indicating Awaiting Acknowledge, Awaiting Data, and, in the case of unsuccessful communications, Comms Fail. This informs the operator of which communication stage is in progress.

RQ-7B Shadow Control System