# CGT50 INTRODUCTION

(OCTOBER 2022)

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# 1. CGT50 VTOL UAV (CGT50)

The CGT50 UAV is a T-Tail UAV with a wingspan of 4.75 m. It is produced from composite material. With a curb weight of 43 kg, the CGT50 has an MTOW of 60 kg. Thanks to its 100cc gasoline engine with a fuel consumption of 1.2 liters under optimum conditions, it can be performed with a cruising time of up to 6 hours.

There is a 350 Watt alternator depending on the CGT50 main engine. This alternator provides 14V DC energy and supplies all subsystems. The IHA has one battery with the capacity to feed the system for 45 minutes as a backup. In case of alternator failure, the battery is activated directly.

The CGT50 uses Avionics Mini as the mission control system (autopilot). Avionics Mini is manufactured by UAVERA Aviation Systems Inc. (UAVARA). Its software and hardware are fully native and fully compatible with the 100% domestic UAVERA Remote Control System (UAVERA UKS) produced by UAVERA. UAVERA UKS has been prepared in a way that can be customized according to customer requests upon request.

The CGT50 can be used by a team of two. Thanks to autopilot, it can perform its entire flight (take-off - mission - landing) fully autonomously.

| PERFORMANCE FEATURES | |
|---|---|
| **Engine** | 100 c Gasoline Engine |
| **Range** | 50 kms |
| **Max. Altitude** | 18.000 ft. MSL |
| **Max. Cruising Speed** | 70 knots |
| **Cruising Speed** | 45 knots |
| **Wind Limits (Takeoff and Landing)** | 23 knots |
| **Wind Limit (Cruising)** | 45 knots |
| **Travel Time (with 9 kg payload)** | 6 Hours |
| **Cargo Capacity (6 hours in Travel Time)** | 9 kgs |
| **Gimbal Capacity (6-hour Endurance)** | 5 kgs |
| **Landing Area** | 20x20 meters |
| **Redundant Power System** | 45 mins |

| CGT50 UAV | |
|---|---|
| **Material** | Composite |
| **Takeoff / Landing** | VTOL |
| **Wingspan** | 4.75 m |
| **Length** | 3.05 m |
| **Maximum Takeoff Weight** | 60 kgs |
| **Fuel Type** | Petrol |
| **Air Velocity Measurement** | 2 pcs heated pitot tube |
| **Transport Box** | 3.2mx1.12mx1.02m |
| **Broadband Link** | 2.4Ghz,10Mbs(128 bit SSL) |
| **C2 Link** | 869 / 900 Mhz (128-bit SSL) |

| FEATURES OF AUTOTOPILOT | |
|---|---|
| **Autopilot** | Avionics Mini |
| **Redundancy** | Flight Critical Sensors Redundant |
| **Automation** | Fully Autonomous (Takeoff-Mission-Landing) |
| **MIL-STD** | No |
| **R/C Control** | Yes (Optional) |

**Tablo 1.1:** CGT50 İHA'nın Özellikleri

The CGT50 VTOL UAV has vertical take-off and landing (VTOL) capability. Thanks to this feature, it does not need a track for its use. It carries out its take-off and landing thanks to the electric motors it has. CGT50 takes off from the take-off stand and lands on a flat area of 20x20 m2 with certain GNSS coordinates.

**Pic 1.1.:** CGT50- VTOL

The fact that the CGT50 does not need runways or catapults makes the UAV ideal especially in applications where mobility is required, in areas where the take-off/landing area is insufficient/limited, and in places where there is no runway.

**Pic 1.2.:** CGT50 VTOL UAV

## 1.1 Mission Control System

CGT50 UAVs use 100% domestic Avionics Mini produced by UAVERA as a mission control system. The Avionics Mini consists of a dual-redundant PilotUS autopilot and a power management unit. Autopilot is redundant on flight-critical components (IMU, GPS, Barometer, Air Velocity Sensor,

Compass) and has reverse voltage protection on it. The I/O ports on it allow subsystems such as telemetry, RC, gimbal, EFI to communicate with autopilot. RTK GPS option is provided as standard to improve accuracy. Thanks to the Tualcom anti-spoofing antenna, itis resistant to counterfeiting. [2]

Avionics Mini also has a CAN communication port. In this way, the desired additional systems can be integrated into the system very easily and without pin restrictions.

AviyonikMini provides backup datalink line via Videolink modem. The integration of AviyonikMini with many Gimbal and COBHAM Aviator200 Satellite Modem has been completed.

Thanks to the unique algorithms developed by UAVERA, the integration and tests of the autopilot have been carried out on many UAVs such as fixed wing, delta wing, H-Tail, T-Tail. Hand launch, runway, catapult, parachute, even VTOL (vertical takeoff and landing) have all takeoff/landing capabilities. PilotUS, which provides fully autonomous flight from Takeoff - Mission - Landing, has over 3,000 hours of flight experience.

**Resim 1.4.:** Avionic Mini


**Resim 1.5.:** PilotUS Autopilot

**Table 1.4.:** Ready-Connected Components

| **Ready-to-Connect Components** | |
|---|---|
| 8 discrete servo connections (signal and power) | Ignition on/off control (Digital I/O) |
| VTOL signal output (4x ESC pwn signal) | Flashing LED on/off control (Digital I/O) |
| Telemetry connection (RS232 & TTL) | Fuel sensor (Analog I/O) |
| RTK connection port (RS232 & TTL) | FPV on/off control |
| EFI connection port (RS232 & TTL) | 2x GPS antenna connection |
| RC port (PWM/PPM input) | 2x Pitot tube connection |
| Redundant Telemetry/Videolink connection (RS232 & TTL) | Programming port (software update) |

**Table 1.2.:** Technical Specifications of Avionics Mini

| **Technical Specifications** | |
|---|---|
| Fully autonomous flight control | 2x Air Velocity Sensor |
| Redundant Pilotus | 2x Digital Compass |
| 7 - 17 V DC Power Input | 2x Altimeter |
| Compatible with UAVERA UKS | 2xIMU |
| ESD protection on all inputs/outputs | 2xGPS |
| Reverse voltage protection | Voltage Sensor |
| 6.0V 40A PMU | -20°C to +50°C operation capability |

## 1.2. Communication System

CGT50 UAV uses 3 separate communication systems for datalink, videolink and FPV camera system: Datalink communication system broadcasts in the 2.4 GHz band in the range of 900-922 or 869 MHz.

Communication systems are independent and can be changed. Any type of modem and antenna that can provide the optional, necessary connection can be used. In standard systems, the range is 50 km LOS. Control of the systems via Satellite is also possible, in which case the range becomes related to the duration of the flight.

## 1.3. Power System

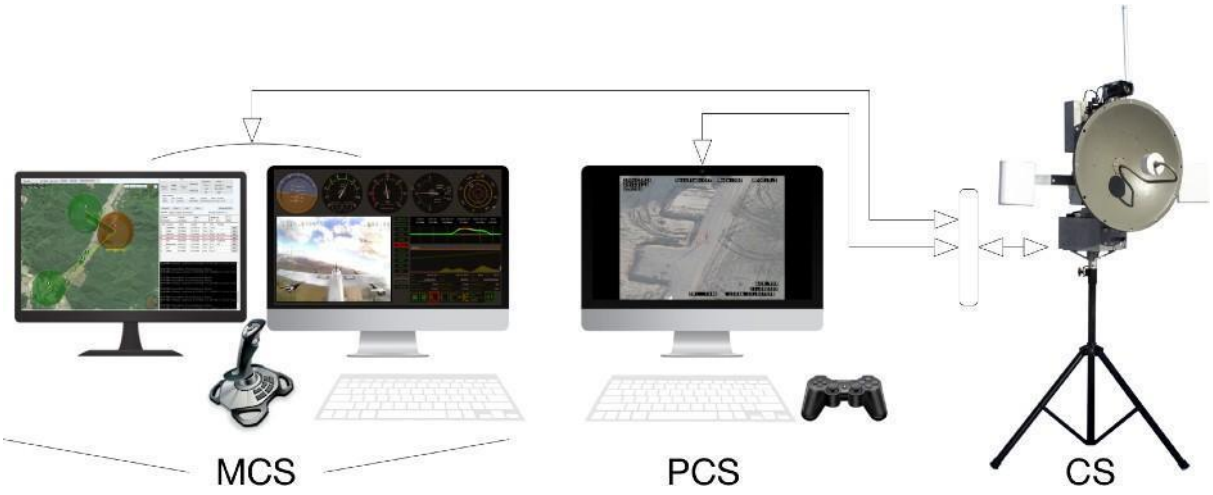
The CGT50 uses a petrol engine with a 100cc injection system. Thanks to the engine's EFI system, flights can be made up to an altitude of 18,000 ft. The engine consumes about 1.2 liters of fuel per hour under optimum conditions. CGT50 has a fuel capacity of 14 lt.

The motor's 350 Watt alternator meets all the needs of the system. The aircraft is also equipped with a spare Battery that can provide energy for 45 minutes. This system allows the aircraft to safely return and land in the event of an alternator failure.

# 1.4. REMOTE CONTROL SYSTEM

UAVERA Remote Control System (UKS) has been developed by our company for flight planning, control and observation, payload control, real-time surveillance and image recording. UAVERA UKS is compatible with all UAVs that are manufactured and/or integrated in our company. In this way, it is possible to control different types of UAVs (Mini UAV, Small UAV, Drone, Target UAV, ISR UAV, etc.) using a single UKS.

**Diagram 2.1:** Remote Control System




Our Remote Control System consists of 3 units:

1. MCS : Mission Control System
2. PCS : Payload Control System
3. CS : Communication System

The MCS software used in UAVERA UKS is 100% developed in our company. The source code belongs to us. The software can be easily and quickly customized in line with customer needs and demands. Communication and control interfaces that will be required by different useful loads can be added to the MCS software. The necessary software changes can be made for new mission types and maneuvers, and system capabilities can be increased by coordinating with autopilot.

## 2.2. Mission Control System (MCS)

The Mission Control System (MCS) can only be managed by one operator. UAVERA MCS has been developed with ease of use in mind. The operator can visually mark the points (waypoint) on the map with the help of the mouse, create and/or change tasks with click-and-drag ease. The missions are not active without giving the loading command to the UAV and flight safety is not damaged. Commands that can be used in emergency situations are determined before the flight and commands can be easily given with a single click in case of any emergency.

The Mission Control Operator (MCO) is responsible for carrying out pre-flight checks, issuing flight reports, identifying, implementing and modifying missions (takeoff, mission, landing), observing critical flight data during the mission and making the necessary intervention. In order for MCO to fulfill this responsibility smoothly and safely, the interpretation of data is facilitated in MCS with both graphical and gauge indicators (Figure 2.2).

**Figure 2.1:** Mission Control System Interface

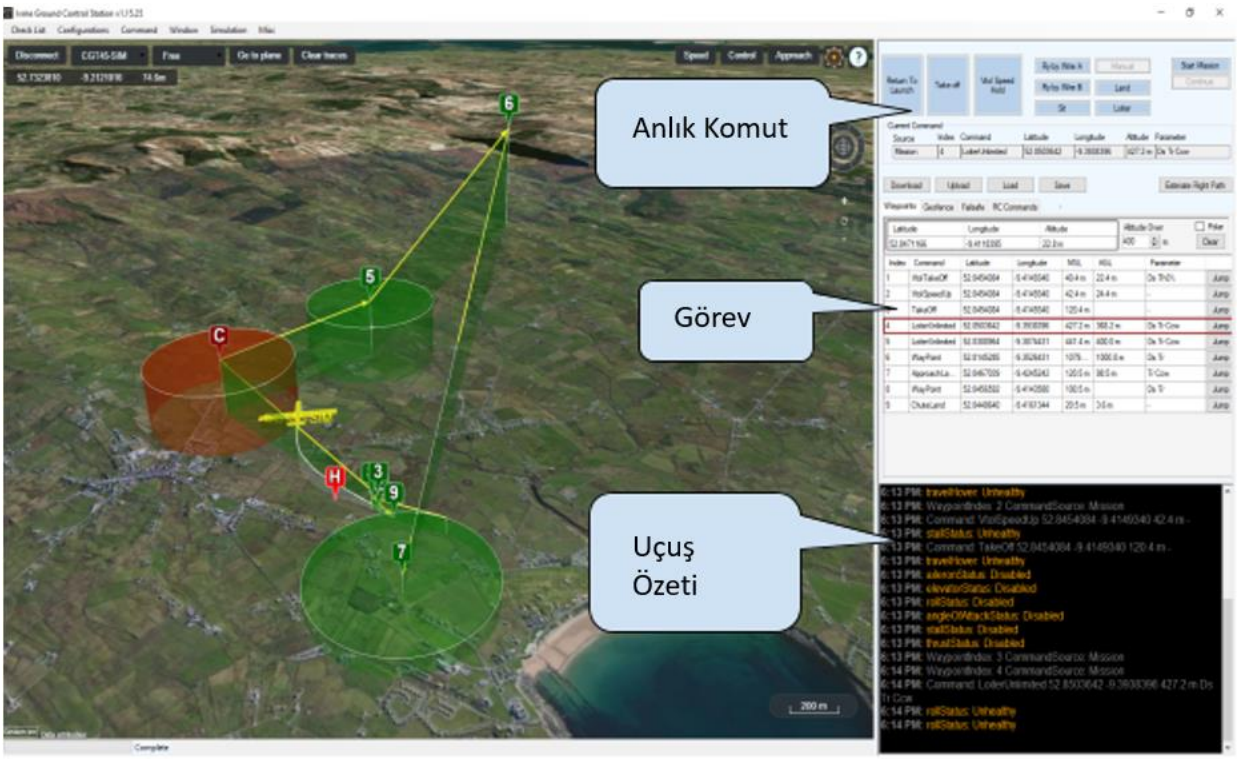
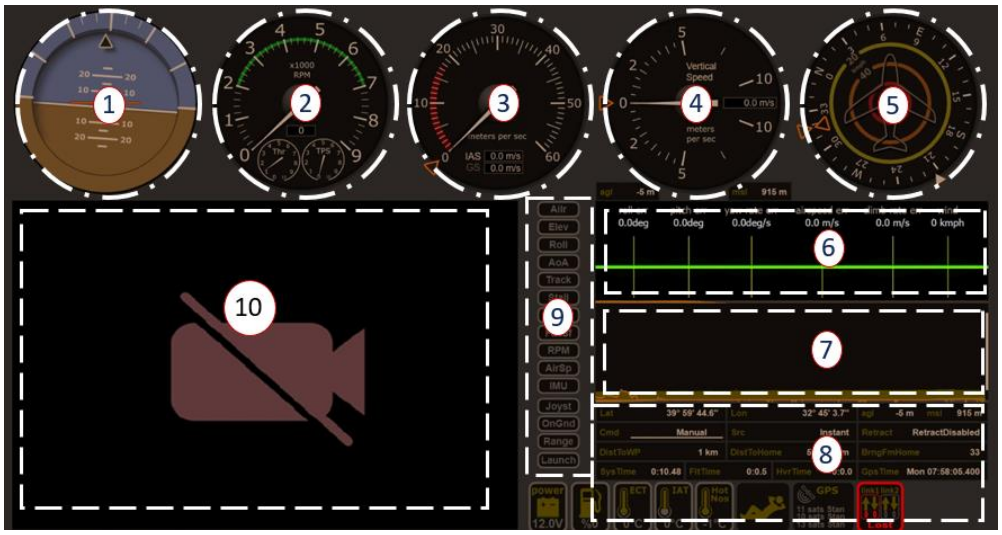


**Figure 2.2:** Gauge Instrument Display

1-Artificial Horizon Indicator
2-Engine Indicator
3-Speedometer
4-Vertical Speedometer
5-Wind and Direction Indicator
6-Error Graph
7-Altitude Graph
8-Flight Data Screen
9-Led Indicators
10-FPV Camera Screen




## 2.3. Payload Control System (PCS)

The Payload Control System is used by the Payload Operator (FYO). PCS software is developed and offered by payload providers. Requested software can be installed on UAVERA PCS. The communication between the payload and the software is carried out by the Communication System (CS) to which the PCS is connected. FYO can easily control the gimbal on the UAV, usually with a single controller.

**Figure 2.3:** Payload Control System Images (Sample)



Although the following useful loads are recommended by us, other useful loads can be integrated into our system if desired:

- UAV Vision : CM142A, CM202
- Octopus : Epsilon Series (140 series, 175, 180)
- CloudCAP : TASE200, TASE400, TASE400 LRS
- VEGA : SPECTRUM 5500

## 2.4. Communication System (CS)

Our communication system in our Ground Control Station consists of the necessary modems and the following antenna. Our communication between the aircraft and the UKS is carried out with AES128 encryption.

Videolink modems can also be used as data links. This allows redundant data linking.

It is also possible to use a modem for CGT50 systems that allows control from satellite. In this case, data services are provided from TURKSAT.

**Figure 2.4:** UAVERA Follow-Up Antenna System

The Pilot Camera image is transmitted from the same line as the gimbal image as an IP broadcast. The necessary antennas are integrated into the CS.

If it is desired to add optional and/or backup RC control capability, the transmitter is placed on the UAV side and an RC controller is delivered with CS in addition to UAVERA UKS.

## 2.5. MCS Software Technical Specifications

### 2.5.1. Basic Functions

- User-friendly interface
- Fully autonomous takeoff, landing and mission identification
- VTOL, Runway, Hand, Catapult take-off support
- Manual, semi-autonomous, fully autonomous flight modes
- Instant and real-time display of flight-critical information (graph and gauge)
- Limitation of capabilities such as the amount and speed of lying down, speed of change of direction, speed of climb for each type of UAV separately
- Real-time tracking of more than 100 variables
- Checking flight-critical information 10 times per second
- Task planning using 2D/3D map
- HandOFF/Handover option (The same aircraft can be operated by two UKS)
- Remote control of payload servos
- Automatic backup of maps for offline use (cache)

### 2.5.2. Advanced Functions

- Pre-flight checks (checklists) can be made from the MCS screen.
- In case of deficiencies in pre-flight controls, the system does not give flight permission and locks the equipment (Optional)
- Ability to control multiple UAVs at the same time on a single MCS map screen, to assign tasks, to make mission changes
- A group of UAVs to fly in formation or communicate with each other and share missions (SWARM Capability)
- Simulating the planned mission in pre-flight accelerated mode to create a flight profile
- Automatic generation of a summary report on the completed task (flight time, commands given during the flight, warnings to the operator, etc.)
- Conducting a reasonable check on the job description and requesting to report / confirm the unreasonable issues to the operator (sanity check) (distance to home, distance between points, distance traveled as VTOL, assignment under the ground, etc.)

- Sharing / publishing telemetry information to a designated network upon request
- Playback of a telemetry broadcast from the network from any desired remote point
- The ability to play back a flight that has already been done step by step using the flight log, in sync with the FPV video
- Simulator operation mode
- Random emergency occurrence in simulator mode

### 2.5.3. Automatic Task Identification Commands and Capabilities

- Vertical Takeoff and Landing
- Point roaming (waypoint)
- Loiter
- Area Scan
- Ability to give different radius for each loiter point
- Ability to order a different cruising speed or full throttle for each point
- Momentarily changing speed, altitude and turning radius
- Ability to loop any flight pattern with the Jump command
- Define a scan task by selecting an area
- Ability to provide 256 mission points

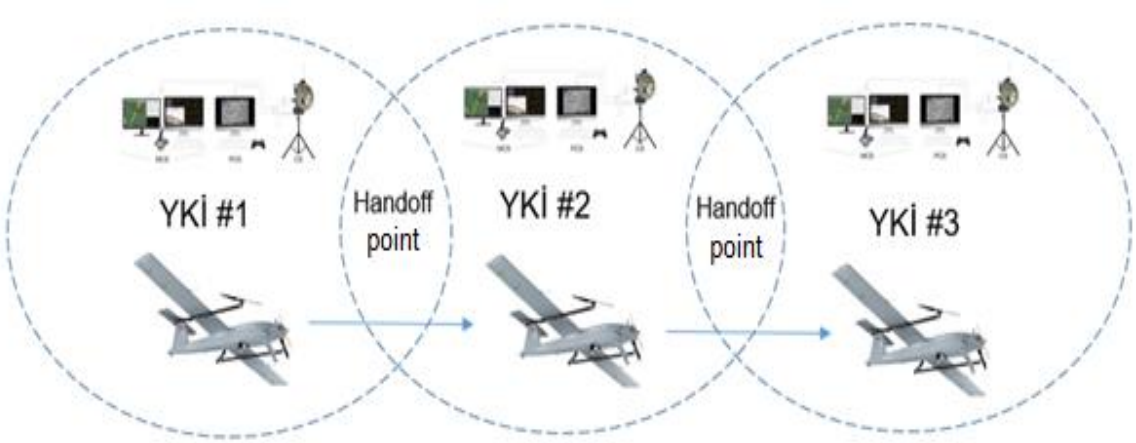
### 2.5.4. Emergency Measures and Capabilities

- Audible and video alert in case of emergency
- Flight area limitation (geofence)
- The RC control signal or the command to be operated in case of ground control disconnection can be determined before the flight.
- In case of GNSS loss, the ability to circle until you receive the signal (loiter)
- Ability to return to base in case of telemetry breakage
- Manual or semi-automatic operation with RC controller if desired
- Semi-automatic steering with joystick via MCS
- Ability to steer the aircraft with the arrow keys in the MCS software window
- Perform sequential commands by jumping to a specific task point when one of the designated emergency modes occurs

### 2.5.5. Handoff Property

Thanks to the handoff feature in UAVERA UKS, a UAV removed from one area can be transferred to the control of another UKS at a remote point. This feature can be used with a single aircraft with many YKIs.

**Figure 2.5:** Handoff Property




## 2.6. Training Function with Simulator

UAVERA UKS offers a real-time and simulator-connected training module. Thanks to this module, MCOs can carry out both their initial training and their re-training at much lower costs and safely.

The autopilot software, which is placed in the Training Module and shows the same features as on the aircraft, communicates two-way with the simulator program. The UAVs used by the system, the simulator is also modeled in accordance with the reality.

At the beginning of the training, environmental conditions (wind direction, type and intensity, precipitation status, etc.) are determined in the simulator software. When the "Connect to Aircraft" command is given, the MCS is connected to the simulated UAV in the simulator environment and receives the position and status values from the simulator and the sensor data such as pitot, GNSS etc. 1-1 as it comes from the UAV in normal flight. When the mission is started, all controls generated by the autopilot (aileron, stabilized, power, etc.) are transmitted to the simulator and can be controlled in the aircraft simulator environment. The status information resulting from the controls given is transmitted to the MCS. In this way, MCO can see the UAV flying in the simulator environment in the MCS, observe its behavior in environmental conditions, give tasks as in real life, change it and improve its mastery of the software.

Another benefit of the Training Module is that it allows the trainer or candidate to develop familiarity with emergency situations. During the simulation, the engine can be stopped on the simulator, sudden wind can be added, GNSS can be turned off and an

emergency situation is created by making similar interventions and how the candidates behave in these situations can be observed, their behavior and reactions can be improved.

The training module also has a random emergency generation mode. In this way, the response of the trained MCO to emergency situations can be evaluated and improved.

# 3. APPLICATION AREAS

## ISR (Intelligence, Surveillance and Reconnaissance)

ISR applications are one of the areas where UAVs are used the most. The CGT50 UAV has a long air-sustaining capability and high payload capacity that is very useful in ISR missions.

The use of ISR in the state and civil sphere can be exemplified by the following articles:

- Surveillance and reconnaissance
- Border control and security
- Drug enforcement
- Counterterrorism
- Firefighting
- Leakage control
- Forest control
- Highway inspection
- Hyperlink control
- OSB audit
- Asset Management
- Military use

## Border Security

Borders should be kept under 24/7 observation. The CGT50 has a Handoff Feature, and border security can be easily ensured with the help of multiple UKS and CGT50s.

Our UAVs can be transferred between different UKSs thanks to the Handoff feature, so that long borders can always be kept under observation.

## Search and Rescue

The CGT50 provides long air retention and enables long-term search and rescue work at once. Thanks to its VTOL take-off/landing capability, the CGT50 allows search and rescue operations to be maintained even in difficult areas.

# 4. MAINTENANCE/REPAIR

In order to ensure the safe execution of the missions and airworthiness, the necessary

maintenance for the CGT50 UAV has been determined. UKS Operators and Technicians are trained to perform a large part of these maintenances.

## 4.1. Maintenance Levels

The maintenance levels of the CGT50 UAV are as follows. UKS Operators and UKS Technicians have the ability to perform the first three of these levels in the field.

- Pre-Flight Maintenance
- After Flight Maintenance
- Scheduled Maintenance (50, 200, 600.2400 flight hours)
- Factory Level Maintenance (Performed in our facilities.)

### PAYLOADS (USING LOADS)

The CGT50 is designed to work with different payloads with its Avionic System. These payloads can be specified as cameras, lidar sensors or intelligence sensors. Currently, OCTOPUS brand Epsilon series cameras are used with our products, different payloads can be mounted on the aircraft and offered for use in a short time depending on the need or purpose of use. Listed below are some of the cameras that work with our UAV.

- UAV Vision : CM142A, CM202
- Octopus : Epsilon Series (140 series, 175, 180)
- CloudCAP : TASE200, TASE400, TASE400 LRS
- VEGA : SPECTRUM 5500

### CLOUD GCS (Cloud Based Ground Control Station)

The CGT50 UAV system can also be controlled by a cloud-based ground control system if desired. This system enables the data to reach the cloud base via the LT or Satellite Modem mounted on the aircraft, so that the pilot can fly the aircraft even from a very different point from the aircraft. While a pilot can traditionally fly only one UAV, thanks to this system, the pilot can control more than one UAV, and if desired, different users can follow the flight and operation as monitors.

The cloud system works with AWS and can optionally be installed on customer-owned servers. In this way, the security of the data is maximized and the information obtained can be kept only with the customer.

A phone, tablet or computer with internet access is sufficient to use the system. The system, which runs on a web browser, allows the control of more than one aircraft from any place with internet access, thus increasing the monitoring and coverage area to the maximum level.

### RADAR SECTION AREA (RCS)

It has been observed that our CGT50 UAV has a radar cross-sectional area of close to 1.3 square meters in the studies carried out so far. Likewise, it is known that our Target aircraft, known as CNG, has a Radar Cross Section area of less than 1 square meter. In the studies to be done with Radar Absorber paint, it is theoretically known that the radar signals will be absorbed at least 50% and thus the existing radar cross-sectional areas will be halved. (Theoretical information about radar absorbing paint is provided by the paint manufacturer, and there may be differences in application and results.)

On the other hand, the Radar Cross Section Area will be reduced to a smaller level by making hull and aerodynamic changes according to the wishes of our customers and depending on the amount of product to be ordered in our CGT50 aircraft, of which we are the manufacturer.