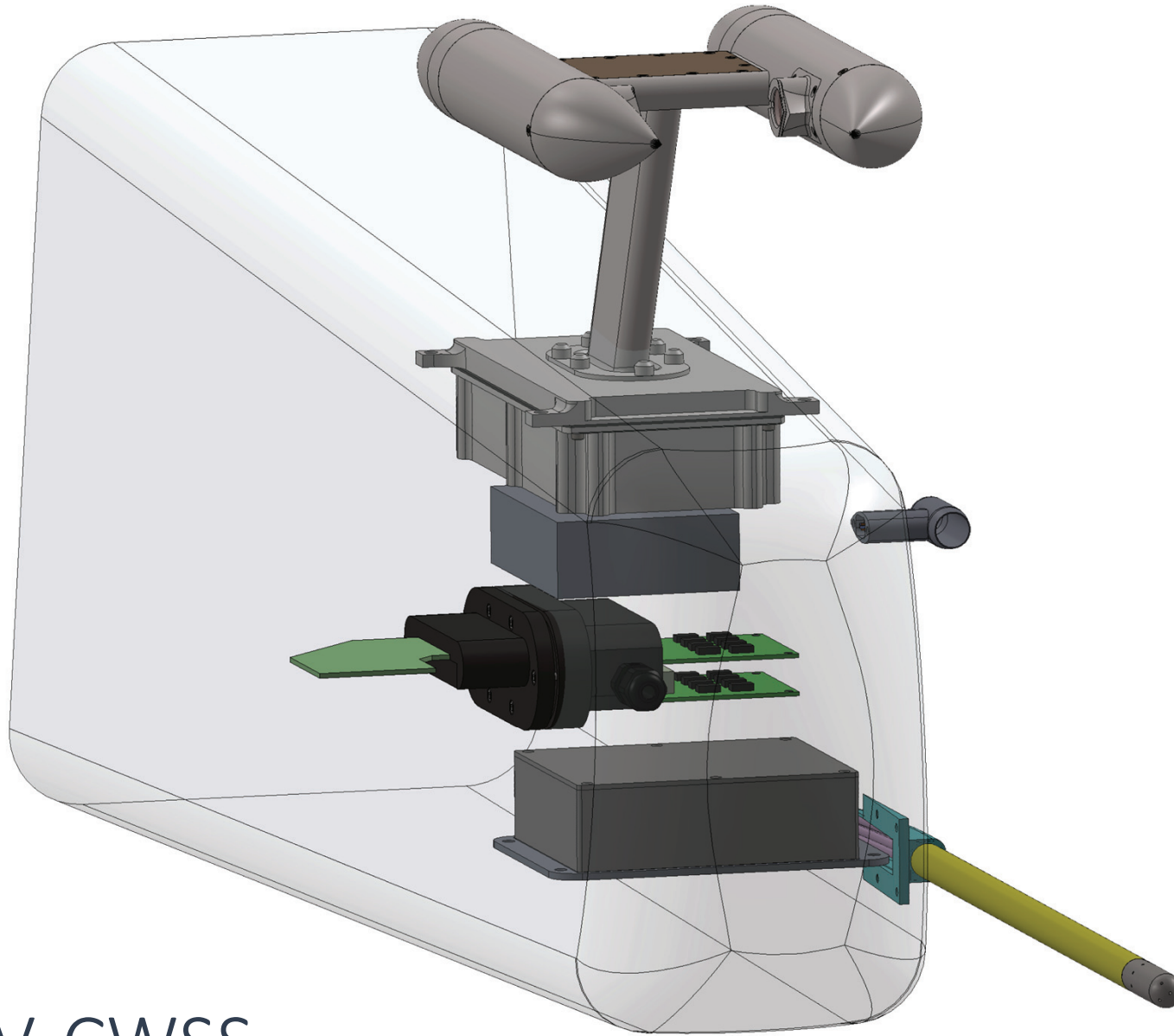
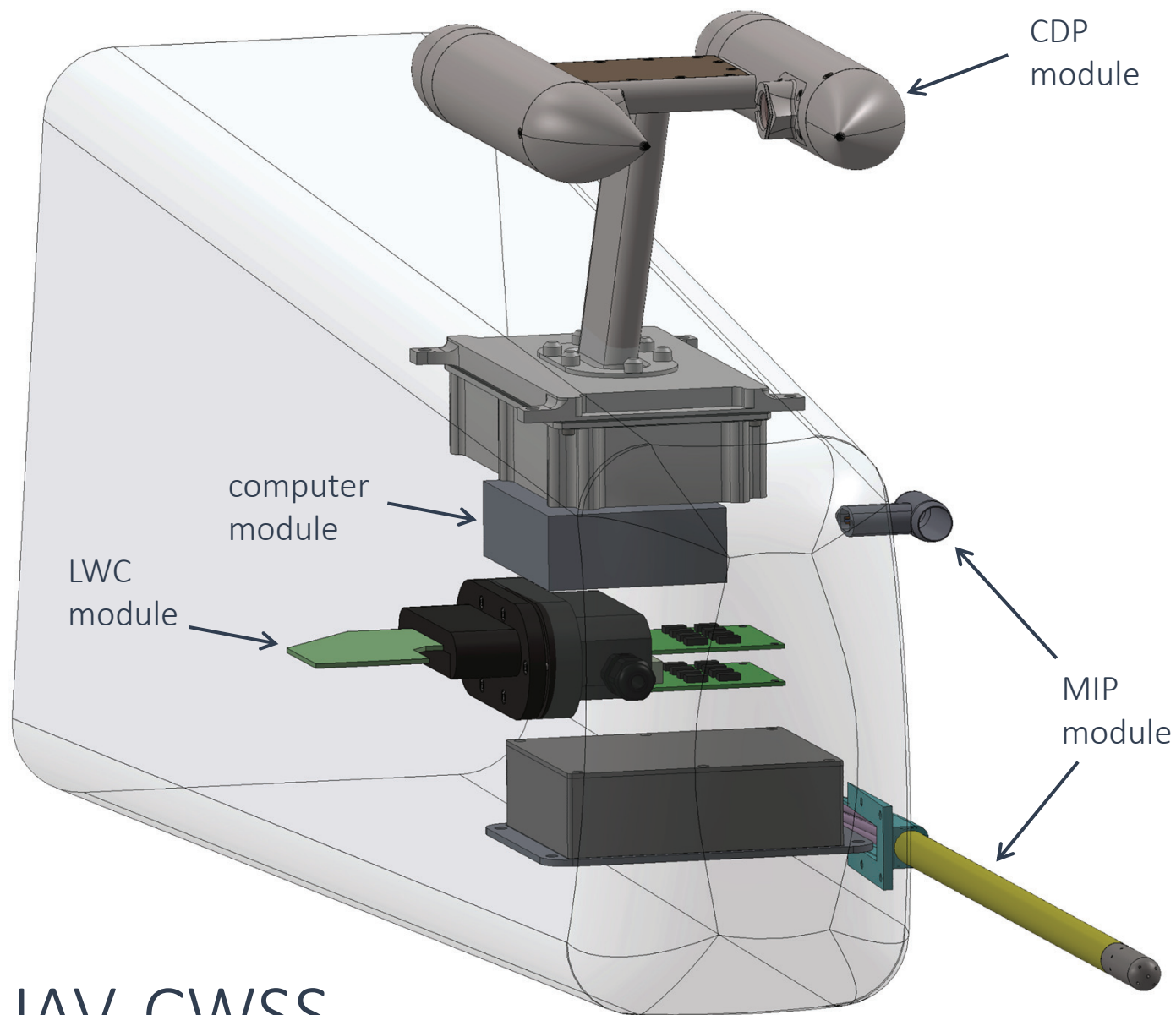


Droplet Measurement Technologies UAV Cloud Water Sensing System (UAV-CWSS)

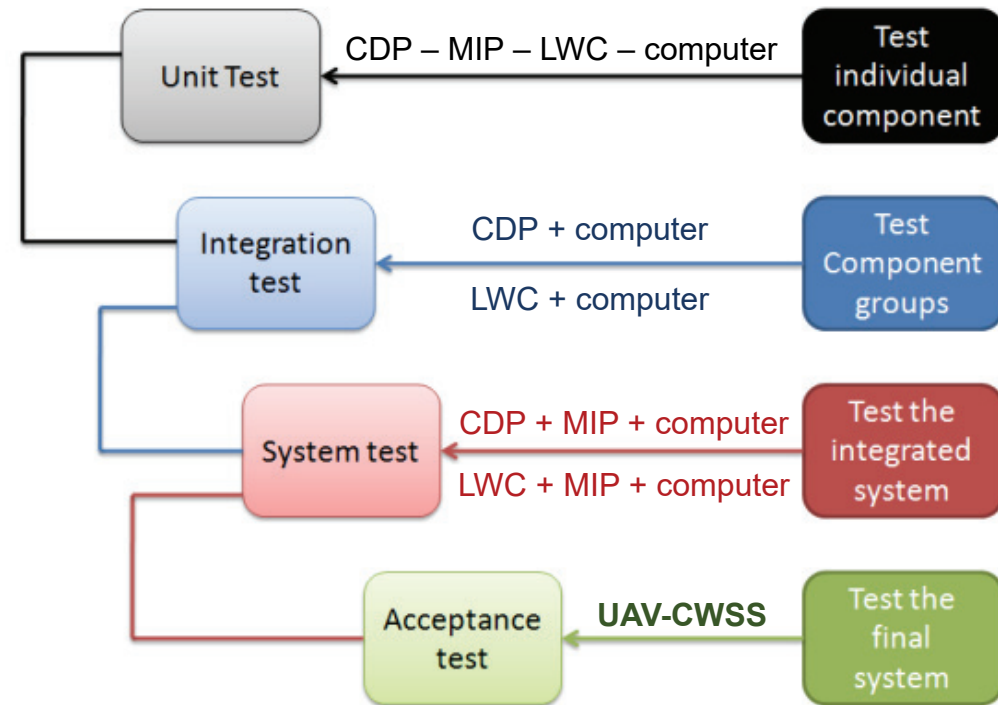


UAV-CWSS
by Droplet Measurement Technologies





UAV-CWSS
by Droplet Measurement Technologies



The UAV cloud water sensing system (UAV-CWSS) is an integrated system of sensors for autonomous measurements of cloud droplet concentrations, liquid water content and 3D wind.

The UAV-CWSS consists of several components that are designed and tested as a tightly integrated system.

Acronym	Full name
CDP	Cloud Droplet Probe
LWC	Liquid Water Content
MIP	Miniature Inertial Probe
PADS	Particle Analysis and Display System

Component	Input power (V DC)
UAV-CWSS CDP-2 UAV module	28
UAV-CWSS LWC-UAV module	28
UAV-CWSS MIP module	7-30
UAV-CWSS data system computer module	12

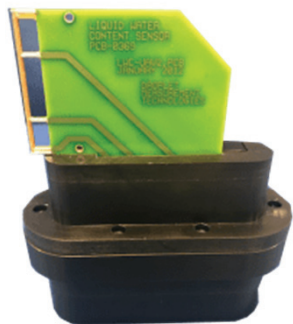
Component	Weight (grams)
CDP-2 UAV sensing head and electronics	840
LWC-UAV hot wire card	230 *
LWC-UAV electronics	190 *
MIP air data boom	44
MIP TRH sensor and sensor housing	24
MIP electronics and inertial system	156
MIP dual GPS	116
Data system computer	400 *
Misc wiring	200 *
TOTAL (estimated)	2200

** Weights are estimates*

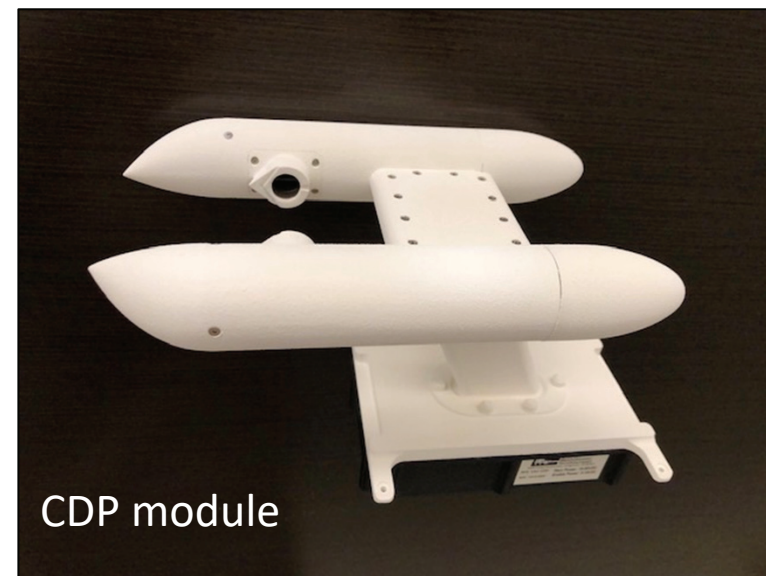
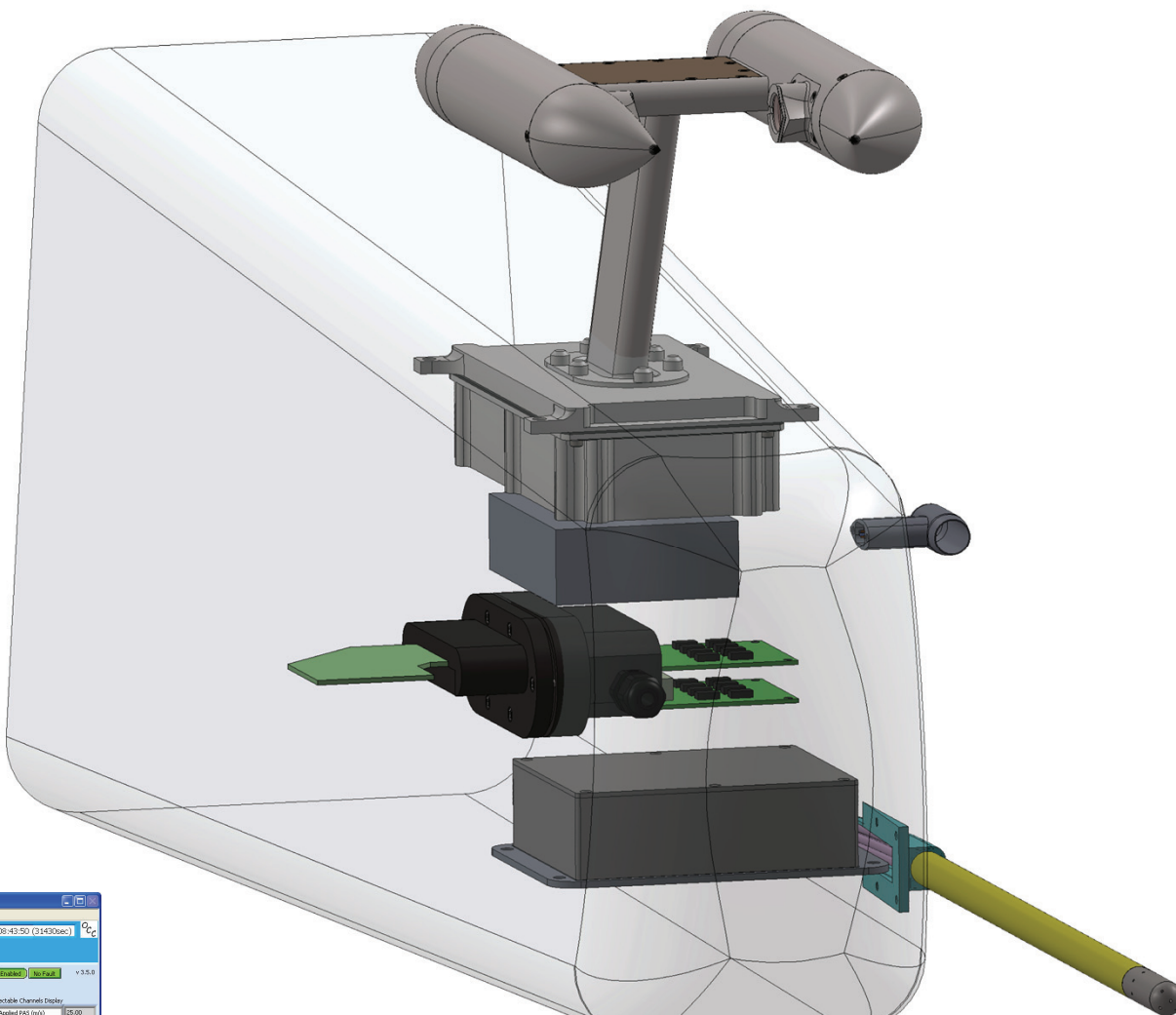
The UAV-CWSS integrated system is designed by Droplet Measurement Technologies. Specification report prepared in consultation with engineers at Droplet Measurement Technologies.



computer
module



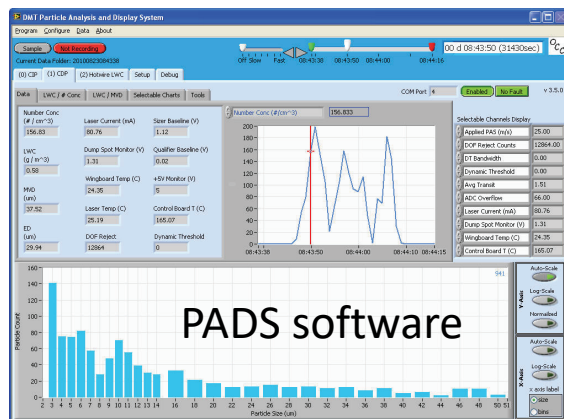
LWC module



CDP module



MIP
module



PADS software

UAV-CWSS
by Droplet Measurement Technologies

Particle Analysis and Display System software

- The Particle Analysis and Display System (PADS) is LabVIEW-based software that features an easy-to-use interface, with one tab for each module in the system. This system will allow the user to send data to other computer systems.
- Raw data are preserved in a separate file and can be reprocessed, allowing for post-sampling calibrations and corrections to variables like airspeed that affect particle concentrations.
- All probe housekeeping channels can be renamed and reprocessed.
- Data files are saved in csv and time variables are presented in accessible format (e.g., HH:MM:SS format in addition to seconds since midnight).

Cloud Droplet Probe module

- The CDP is a forward-scattering optical spectrometer. For accurate sizing, the CDP accepts and sizes only particles that pass through a region of the laser beam with uniform power.
- A compact, lightweight cloud particle spectrometer that measures particles in the 2 to 50 μm range.
- PADS allows the user to control the CDP and display real-time data and logs. For instance, the program enables the user to do the following tasks:
 - Sample and record data
 - View particle volume and number concentrations, as well as Median Volume Diameter (MVD) and Effective Diameter (ED)
 - Monitor instrument parameters like CDP laser current and various electronics voltages
 - Play back data for post-flight viewing
 - Reprocess data with new parameters for additional analysis

Cloud Droplet Probe module - specifications

Parameter	Specification
Measured Parameters	Single-particle light scattering
Derived Parameters	Particle diameter Particle number concentration Effective diameter (ED) Median volume diameter (MVD)
Particle Size Range	2 – 50 μm
Number Conc. Range	0 - 2000 particles/cm ³
Typical Sample Area	0.24 mm ²
Number of Size Bins	30
Air Speed Range	> 10 m/sec
Sampling Frequency	Selectable, 0.04 to 20 seconds
Refractive Index	Non-absorbing, 1.33 (the industry standard for water)
Light Collection Angles	Optical design: 4° - 12° Optical performance: 1.7° - 14°
Laser	658 nm, up to 50 mW
Power Requirements	System Power: 28 VDC at 2A

Liquid Water Content module

- A compact sensor card that precisely measures liquid water content (LWC) from 0 to 3 g/m³.
- PADS allows the user to control the LWC and display and log data. For instance, the program enables the user to do the following tasks:
 - Start data recording and sampling
 - Automatically estimate LWC from convective heat losses, wire temperature, air density, and various constants and intermediate values
 - Estimate convective heat losses using direct measurements or an empirically derived method

Liquid Water Content module - specifications

Parameter	Specification
Measured Parameter	Liquid water content in the 0-3 g/m ³ range
Frequency Response	>25 Hz
Output	RS-422 Serial Communication
Special Features	Interchangeable circuit card sensor Pulse width modulation control (avoids overheating of the power transistor and hotwire coil)
Power Requirements	System power: 28 VDC, 8 A max

Mini Inertial Probe module

- A compact sensor that precisely measures UAV position, inertial parameters, angle of attack, angle of sideslip, pressure, true air speed, 3D wind, temperature and relative humidity (TRH).
- Derives u, v and w wind components with reference to the earth frame (meteorological wind).
- Sophisticated TRH housing design to prevent biases due to aircraft motion.
- PADS allows the user to display and log MIP data.

Mini Inertial Probe module - specifications

Parameter	Specification
Measured Parameters	Temperature, relative humidity, atmospheric pressure, true airspeed, angle of attack, angle of sideslip, GPS altitude, GPS latitude and longitude, GPS groundspeed, GPS track, x-y-z velocity and acceleration, magnetic heading, true heading, turn rate, yaw angle, pitch angle, roll angle, vertical velocity.
Derived Parameters	3D wind speed and velocity
Frequency Response	>10 Hz
Output	RS-232 Serial Communication
Special Features	Rugged for UAV operations Derives 3D wind relative to earth frame of reference as required by meteorologists
Power Requirements	System power: 7-30 VDC