



Flight Calibration Services

Colibrex

Smart Drone Solutions



Drone Measurements

Drone-based Radar Measurements

Colibrex / FCS RadarDrone
New capabilities to measure ATC surveillance systems

Colibrex/FCS RadarDrone (UAS) for Radar Measurements

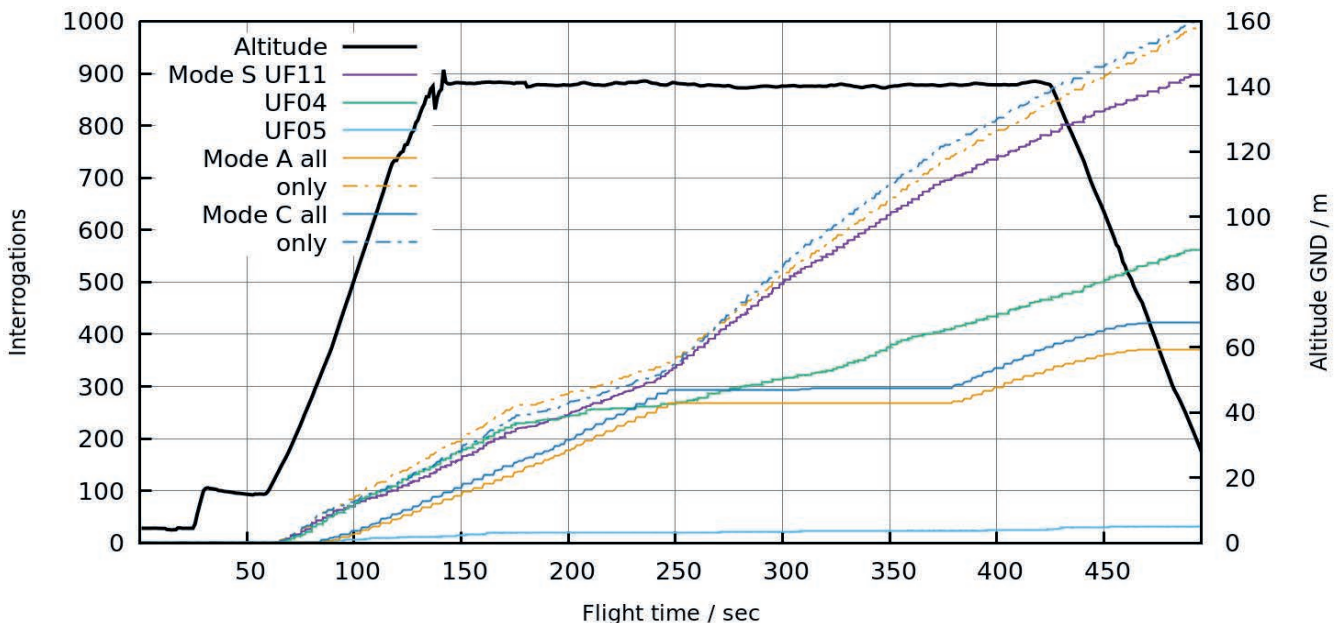
The new Colibrex/FCS RadarDrone is a unique RF measurement tool designed to perform specialized field measurements for commissioning, trouble-shooting or regular maintenance of military or civil radar and surveillance systems including primary (PSR) and secondary (SSR/MSSR) radar installations. ANSP CNS (Communication, Navigation, Surveillance) maintenance staff, radar system manufacturers and radar service organizations can particularly benefit from this new technology.

The Colibrex/FCS RadarDrone features primary radar and secondary surveillance radar (1030/1090 MHz channel) receiver front-ends, antennas and dedicated processing software designed to provide an in-depth analysis of the RF signal-in-space. The RadarDrone is a highly flexible tool as its flight profiles can easily access areas of interest which cannot be reached from the ground, e.g. using telescopic masts. Applications include optimization and setting-up of radar systems (e.g. determination of antenna diagrams) and MLAT systems (e.g. measurement of reflections, optimization of antennas) by analysis of the electromagnetic wave propagation in the near field and far field of such installations. EU Regulation No

1207/2011 requires the member states by June 2020 to assure that SSR transponders are not subject to excessive interrogations. Validation tests to measure these interrogations can be performed at SSR hotspots using the RadarDrone.

The RadarDrone is a system resulting from a multi-year R&D project. It merges the flight inspection and receiving/processing expertise of FCS Flight Calibration Services GmbH and the expertise in design and international commercial operation of RF measurement UAS of Colibrex GmbH.

A documented calibration process for measurement receiver, processing and antennas ensures that all measurement results of the RadarDrone are fully reproducible. The RadarDrone and antenna design was fully simulated in a 3D complex electromagnetic model using a leading electromagnetic solver software. The RF front-end and processing subsystem are lightweight purpose-designed components. The low weight of the payload improves the UAS autonomy, as larger batteries can be carried.



Cumulation of various SSR interrogations (Mode A/C and Mode S) over flight time and altitude

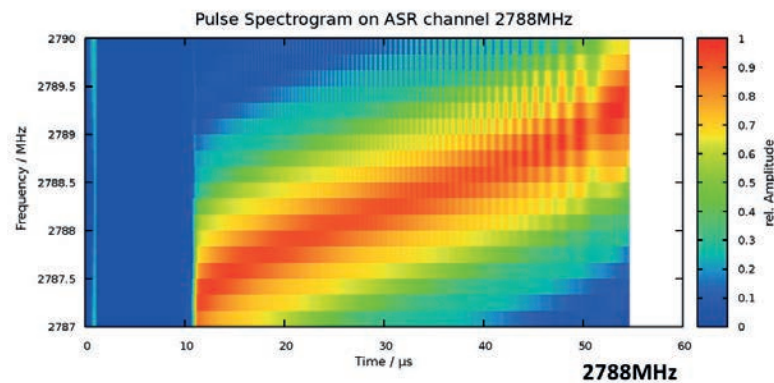
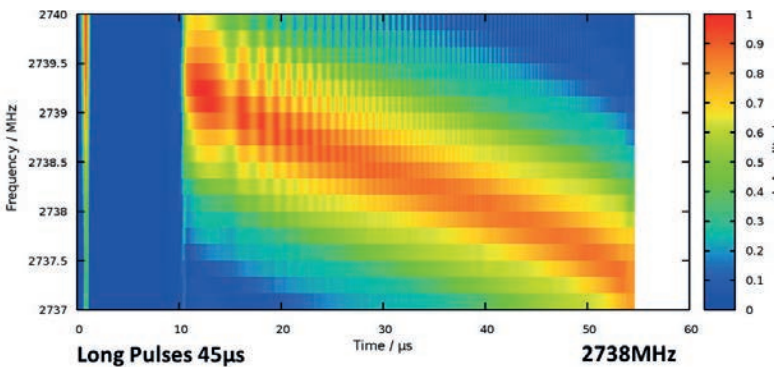
Designed for RF measurements of ATC surveillance and air defense radars (PSR/SSR) and MLAT/WAM

Basic system features

- Dual-channel receiver for simultaneous processing of radars in L/S/C bands
- Measurement of signal pulse and reflections of SSR (1030/1090) and primary radars



The RadarDrone flying in an airport environment



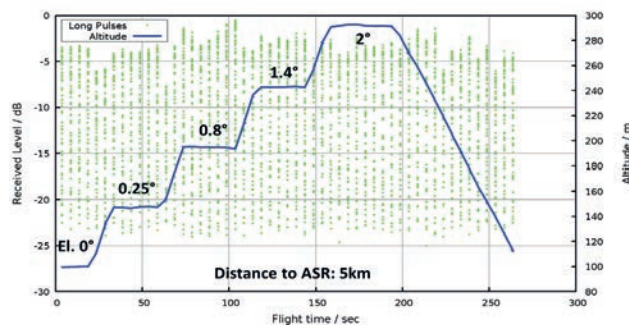
Spectrogram of frequency modulated ASR pulses

- Lightweight purpose-designed RF frontend and processing subsystems
- High bandwidth internal processing and recording on a 1TB SSD, permitting in-channel separation of radar signals and potential interferences

- RTK-based, precise navigation position accuracy of better than 10 cm
- Purpose-designed, L-, S- and C-band antennas with dual polarization
- Computer simulation of drone equipped with antennas, validated by measurements in known RF environment - fully traceable field strength measurements possible
- WiFi interface for transfer of recorded mission raw data to PC on the ground
- All-in-one software incl. mission planning and data analysis
- Advanced drone platform incl. numerous hard and soft safety features; fast deployment and easy logistic (e.g. removable arms and legs, slide-in battery packs for easy swap of batteries, ...).
- Prepared for integration into UTM systems with implementation of dedicated tracking solutions

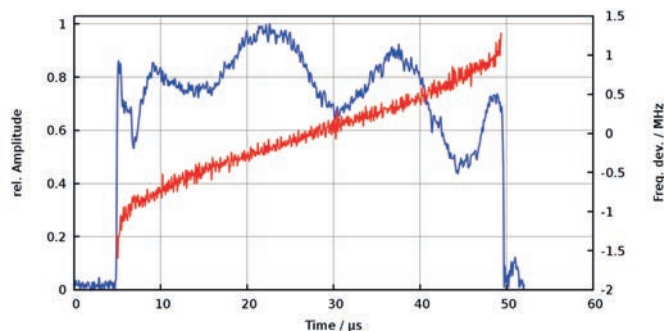
Overview of applications

- Recording of vertical and horizontal antenna gain patterns (PSR and SSR)
- Measurements of PSR pulse load and format-dependent SSR interrogations



Measurements of PSR pulse load and format-dependent SSR

- Optimization of radar tilt
- Low altitude coverage measurements
- Measurement of interferences, e.g. from wind turbine parks



PR pulse deforming due to wind turbine interference

- Obtaining of in-field RF data as input data for electromagnetic simulations
- Assessment of the RF field load including reflections for the optimization of 1030/1090 MHz multilateration MLAT systems (the performance of MLAT systems being highly dependent on the location and characteristics of the sensor antennas)
- Future option: active 1090 MHz transmission for optimization of monopulse antennas and MLAT antenna configurations

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