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PM-235 LPS **local positioning system for the aerobatics competition**

Project

Pos. 1 – 4 4 ground stations

Accumulator battery for at least 14 hours continuous operation at 8 hours of charging time, 868 MHz radio station, bi-directional, each station with own identification, which is along-sent during signal request, built-in GPS receiver for exact time and position determination.

Pos. 5 4 - 5 mobile stations in the aerobatic plane

Battery or accumulator battery operation? 868 MHz radio station, bi-directional.
Signal processor, which executes a periodical monitoring of the individual ground stations (approx. 10 – 20 times per second and station). Calculation of the respective position of the aerobatic plane from the measurement signals. Internal storage of the measurement values (possibly only border crossings with duration and distance to the "performance zone" (BOX)) for later readout into the **PM-234** PC-evaluation program (for later analysis at possible controversies).

Transmission of the position (border violation of the "performance zone" (BOX)) to the **PM-234** altimetry device und radio transmission to the **PM-234** ground station together with the altitude data (434 MHz).
A merging of **PM-234** and **PM-235 LPS** in one conjoint station with the dimensions of **PM-234** is given.

The linesmen who are used up to now can be replaced by this system.

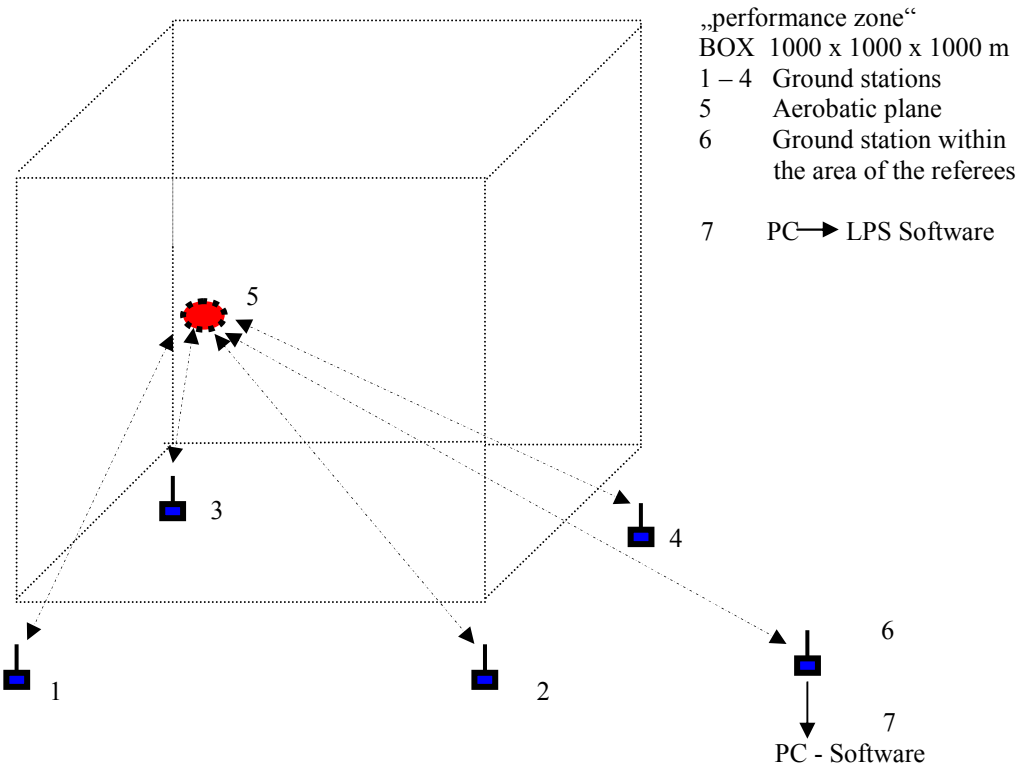
Additional control of the altimetry device by mutual comparison.
The metering precision of the positioning system represents, like the PM-234, approx. 1 – 2 Meter.

Pos. 6 1 ground station within the area of the referees

PM-235 LPS can also work as a single system, for that purpose a separate ground station is necessary, which is installed within the area of the referees. This station is different to the other ground stations. Data interfaces for PC connection, respectively for the readout of the stored flight data (equipped with beeper LED display for error time in 0.1 sec and acknowledgment key).

Pos. 7 1 PC – with LPS or combined PM-234 software

Fig. 1



Measurement principle:

The distance measurement works on the principle of running time and phase comparative measurement. Thereto signals of different frequencies are sent to the respective ground station. The impulse returned by the ground station is compared to the reference signal and the signal processor calculates the distance out of the running time shift and phase shift accurate to a centimeter.
All signals of the ground stations are used together with the altimetry from the **PM-234** to the computation of the accurate position of the airplane (inside and outside of the BOX).

After installation of the ground stations, which does not have to take place necessarily at the 4 corner points, the coordinates of the “performance zone” (BOX) are entered at the PC.
The ground station with the highest altitude is determined as the basis of computation.

If these coordinates are not entered at the PC, the ground stations have to be set up exactly at the corner points and the station with the highest altitude has to be confirmed. An internal inspection observes that this confirmation is made only at one station.

Each flight can be observed 3-dimensional at the PC within a delay of 0.5 – 2 sec. (dependent on the performance of the PC). Of course, the flight can be stored on the PC. Various **ZOOM** – functions and calculations are possible for all 3 axes, thus every flight movement can be analyzed exactly afterwards (i.e.: movement 45° upwards)

The flight attitude is not recognizable with this system (possibly at a later time).

After installation and activation of the ground stations the respective position (over GPS) is recognized automatically and is used for further calculations. (The BOX may only lie within the stations). After termination of a competition day, the stations must be collected and the accumulator batteries must be recharged.
The order of the installation of the ground stations for the next competition day is any. However, in order to avoid the redefinition of the "performance zone" (BOX at the PC), the installation should occur possibly in the same point.

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