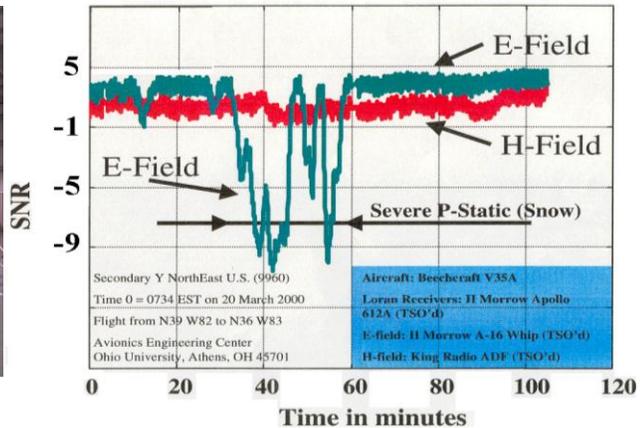


Magnetic Loop Antenna for Precipitation Static Mitigation

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Sponsor: Federal Aviation Administration (FAA)



Precipitation Static (P-Static) mitigation. Left: King Air aircraft is charged at 50 kV on the radome and leading edges to evaluate the discharge rates and currents. Right: First successful flight test demonstrating the immunity of magnetic loop antennas to P-Static.

Precipitation static (P-Static) can cause severe degradation of low frequency signals, such as Loran-C, onboard an aircraft in flight if a wire (E-Field) antenna is used. Aircraft flight through snow, for example, can result in degraded signal-to-noise ratios (SNR) and loss-of-lock, resulting in the loss of the Loran-C navigation function.

To mitigate the effects of P-Static, a magnetic dual-loop (H-Field) antenna system for airborne Loran-C signal reception was designed, implemented and flight-tested. The antenna system consists of a cross-loop antenna and an ultra low-noise pre-amplifier. The pre-amplifier is connected to an aviation Loran-C receiver approved for instrument flight rule (IFR) conditions. An Automatic Direction Finding (ADF) antenna was used, without modification, for the reception of the Loran-C signals. This antenna satisfies Technical Standard Order (TSO) C41b for aircraft ADF antennas. The pre-amplifier was designed to optimize the reception of the Loran-C signals and to combine the signals from the two antenna loops. Both wire and loop antenna systems were tested on a single-engine Beechcraft Bonanza aircraft during normal and P-Static flight conditions. Flight test results show that the Loran-C receiver connected to the wire antenna experienced degraded SNRs during snow-induced P-Static, while the Loran-C receiver connected to the dual-loop antenna was not affected by the P-Static.

Further reading: D. H. van Graas and F. van Graas, "Aircraft Loran-C H-Field Antenna System Design and Flight Test," *Proceedings of the Technical Meeting of the ION*, January 2001, Long Beach, CA.

W. J. Pelgrum, "New Potential of Low-Frequency Radionavigation in the 21st Century," Ph.D. Dissertation, Delft University of Technology, November 2006.